

ARTICLES on design, construction and operation of oil-engines and motorships by the world's foremost writers on marine engineering.

Motorship

ILLUSTRATIONS of the newest designs in international merchant motorship and Diesel-engine construction and auxiliary equipment.

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American Marine Week is November Feature

To Assist in Focussing National Attention on the Marine Industry
the Week November 9-14 Is Organized with Marine
Show and Meetings of 15 Marine Associations

THIS month witnesses the 1925 celebration of American Marine Week, which is now becoming established as an annual event and which has for its purpose the concentration of the nation's interest on the magnitude and importance to this country of shipping and the allied industries.

Again this year the center of interest is located in New York, but the interest of American Marine Week is not sectional nor geographically limited. The scope of American Marine Week is national in character and in form. The American Marine Association, which is responsible for the organization of American Marine Week, has selected New York as the most convenient location for the greater number of those participating in the various activities of the week's program. If any pronounced volume of opinion should favor the centering of American Marine Week at any port on the Pacific Coast or Gulf Coast or at any other port on the Atlantic Coast there is no reason to doubt that the sentiment would be unheeded.

In the endeavor to emphasize the comprehensiveness of the effort that is made during American Marine Week other seaports like Baltimore, Charleston and Galveston have been persuaded to prepare exhibits showing their facilities for shipping and for trade.

In former years the Marine Exposition has been confined almost exclusively to a collection of exhibits representing the various phases of the shipbuilding and

marine engineering industries. This year a broader vision has ruled, and recognition has been given to the importance of picturing some of the aspects of the shipping which the industries just mentioned have brought into being.

Shipping and water transportation, together with the ports and terminals that are dependent upon them find their place in the Show. This being the first year of their participation those sections are not very prominently nor very comprehensively represented. Participation in the Exposition involves expense and not every shipping company, port authority or terminal company finds it possible to appropriate the money for this purpose.

Although the Marine Exposition is the chief feature of American Marine Week other events connected therewith help considerably to advertise it. For instance, 15 marine organizations with 30,000 members will hold their annual meetings, or special meetings that have been arranged, in New York during that time.

More than 50 radio stations covering every state in the union have volunteered to co-operate in broadcasting marine programs. Part of these will consist of the proceedings in New York, while in other instances local speakers will make addresses on marine topics. As an example of the influence that this broadcasting may have one may reflect upon the attention that will be given in many parts of the country to the address of O. E. Bradfute, President of the American Farm Bureau Federation,

who speaks at the Annual Banquet of the American Marine Association on Armistice night, November 11.

United States shipping and the water-borne commerce of the United States constitute tremendous forces in the life of the nation. They are forces of much greater magnitude than are commonly understood. One must take time to stop and reflect upon them in order to appreciate them.

How great a tonnage of large vessels is employed in U. S. trade is concisely shown by the table of figures on this page showing the present situation. The statistics are corrected to October 1 of this year and are therefore right up to date. How many people know that nearly one million gross tons of American vessels are operating today in ocean foreign trade under private ownership and management? How many realize that the gaps filled by Shipping Board vessels are confined to our ocean foreign trade and help to swell our tonnage in that service to the far from insignificant figure of over two and a half million tons gross. If the nearby foreign trade—with the West Indies and Central America chiefly—be included, there is almost as much privately owned tonnage in foreign service as there is Government tonnage.

Over six and a half million gross tons of shipping was actively engaged under the American flag on October 1 in all foreign and coastwise service. That is a very satisfactory total for a nation which, we are still being told, has no merchant marine. That tonnage is not yet enough. We must

Employment of American Merchant Vessels at October 1, 1925

Summary of Privately Owned Steam and Motor Vessels of 1,000 Gross Tons and Over

SERVICES	PASSENGER		FREIGHT		TANKERS		TOTAL—ALL TYPES	
	No.	Gross Tons	No.	Gross Tons	No.	Gross Tons	No.	Gross Tons
Overseas Foreign.....	22	218,360	64	366,842	48	341,696	134	926,898
Nearby Foreign.....	32	136,290	54	147,469	67	392,991	153	676,750
Coastwise	108	487,954	388	1,519,533	187	1,192,692	683	3,200,179
Laid Up.....	6	16,668	102	317,436	31	143,695	139	477,799
Total Private.....	168	859,272	608	2,351,280	333	2,071,074	1,109	5,281,626

Summary of Government Owned Steam and Motor Vessels of 1,000 Gross Tons and Over

Overseas Foreign.....	15	276,850	256	1,488,226	2	14,605	273	1,779,681
Nearby Foreign.....	3	24,888	3	16,361	..		6	41,249
Coastwise	..		..		..		..	
Government Service.....	..		2	9,712	..		2	9,712
Laid Up.....	6	71,736	871	3,705,756	28	161,937	905	3,939,429
Total Government.....	24	373,474	1,132	5,220,055	30	176,542	1,186	5,770,071
TOTAL MERCHANT FLEET.....	192	1,232,746	1,740	7,571,335	363	2,247,616	2,295	11,051,697

Prepared by the Bureau of Research, United States Shipping Board

Waterborne Commerce of the United States, 1924—Foreign, Intercoastal and Coastwise

	TOTAL COMMERCE			FOREIGN			INTERCOASTAL			*COASTWISE			NONCONTIGUOUS		
	TOTAL	Inbound	Outbound	TOTAL	Inbound	Outbound	TOTAL	Inbound	Outbound	TOTAL	Inbound	Outbound	TOTAL	Inbound	Outbound
ATLANTIC COAST PORTS															
New York, N.Y.	43,478,421	25,392,264	18,086,157	21,944,018	9,994,699	11,949,319	5,598,441	5,079,890	518,551	15,348,731	9,974,486	5,374,245	587,231	343,189	244,042
Philadelphia, Pa.	13,836,779	9,362,753	4,474,026	5,404,143	3,104,752	2,299,391	1,188,403	834,063	354,340	7,154,396	5,364,195	1,790,201	89,837	59,743	30,094
Norfolk, Va.	11,539,735	1,312,366	10,227,369	2,836,222	372,701	2,463,521	126,202	36,009	90,193	8,484,272	902,204	7,582,068	93,039	1,452	91,587
Boston, Mass.	11,296,769	10,287,098	1,009,671	2,343,451	2,009,151	334,300	458,972	379,721	79,251	8,426,041	7,830,515	595,526	68,305	67,711	594
Baltimore, Md.	9,344,075	5,866,900	3,477,175	5,424,805	3,563,684	1,861,121	1,180,989	523,478	657,511	2,546,438	1,725,426	821,012	191,843	54,312	137,531
Newport News, Va.	4,233,334	165,690	4,067,644	1,309,530	130,836	1,178,694	7,680	2,531	5,149	2,870,320	32,323	2,837,997	45,804	-	45,804
Providence, R.I.	3,658,690	3,293,114	365,576	556,906	555,094	1,812	66,675	66,669	6	3,035,109	2,671,351	363,758	-	-	-
Jacksonville, Fla.	3,072,192	1,356,916	1,715,276	561,978	386,143	175,835	55,188	50,802	4,286	2,448,741	919,971	1,528,770	6,285	-	6,285
Portland, Me.	2,324,858	1,912,624	412,234	736,212	432,588	303,624	17,325	8,236	9,089	1,571,321	1,471,800	99,521	-	-	-
Savannah, Ga.	1,707,573	1,045,069	662,504	737,303	432,938	304,365	21,852	12,206	9,046	949,018	599,925	349,093	-	-	-
Charleston, S.C.	1,579,235	1,043,705	535,530	786,182	594,289	191,893	22,655	21,503	1,152	769,094	427,913	341,181	1,304	-	1,304
Fall River, Mass.	1,373,291	1,158,502	214,789	774,603	704,853	69,750	231,248	231,248	-	367,440	222,401	145,039	-	-	-
Perth Amboy, N.J.	970,097	884,339	85,758	965,243	884,339	80,904	-	-	-	-	-	-	4,854	-	4,854
Wilmington, N.C.	538,818	488,152	50,666	225,056	198,298	26,758	1,665	1,665	-	309,065	286,409	22,656	3,032	1,780	1,252
Newark, N.J.	352,044	238,099	113,945	163,056	158,948	4,108	188,988	79,151	109,837	-	-	-	-	-	-
Marcus Hook, Pa.	214,722	70,237	144,485	154,830	10,345	144,485	59,892	59,892	-	-	-	-	-	-	-
Bayonne, N.J.	126,262	107,816	18,446	39,769	21,323	18,446	86,493	86,493	-	-	-	-	-	-	-
Clymont, Del.	103,716	103,716	-	103,716	103,716	-	-	-	-	-	-	-	-	-	-
Other Ports	13,967,868	6,768,482	7,199,386	623,799	438,050	185,749	76,582	73,023	3,559	13,265,765	6,257,334	7,008,431	1,722	75	1,647
TOTAL - Atlantic Coast Ports	123,718,479	70,857,642	52,860,637	45,690,822	24,096,747	21,594,075	9,388,650	7,546,580	1,842,070	67,545,751	38,686,253	28,859,498	1,092,256	528,262	564,994
GULF COAST PORTS															
New Orleans, La.	10,513,401	5,661,261	4,852,140	8,160,473	4,476,957	3,683,516	246,887	157,006	89,881	2,003,680	1,015,631	988,049	102,361	11,667	90,694
Port Arthur, Tex.	7,594,748	1,133,408	6,461,340	2,310,263	1,076,632	1,233,631	6,229	5,380	849	5,256,395	51,396	5,204,999	21,861	-	21,861
Galveston, Tex.	5,264,135	2,247,800	3,016,335	3,222,289	1,569,412	1,652,877	52,598	22,860	29,738	1,971,728	655,528	1,316,200	17,520	-	17,520
Houston, Tex.	4,086,386	550,846	3,535,540	1,212,605	335,881	876,724	16,269	14,601	1,668	2,840,815	200,362	2,640,453	16,697	2	16,695
Baton Rouge, La.	3,803,849	672,510	3,131,339	1,290,253	540,276	749,977	54,400	54,400	-	2,459,196	77,834	2,381,362	-	-	-
Beaumont, Tex.	3,439,469	24,322	3,415,147	728,129	529	727,600	-	-	-	2,684,717	23,786	2,660,931	26,623	7	26,616
Texas City, Tex.	3,419,852	440,957	2,978,895	902,406	405,362	497,044	9,303	-	9,303	2,508,143	35,995	2,472,148	-	-	-
Tampa, Fla.	2,166,397	875,788	1,290,609	611,652	303,153	308,499	6,202	6,202	-	1,346,035	566,140	779,895	2,508	293	2,215
Mobile, Ala.	1,746,092	581,465	1,164,627	1,011,501	296,201	715,300	170,838	26,691	144,147	508,189	246,254	261,935	55,564	12,319	43,245
Sabine, Tex.	1,197,907	830,004	367,823	335,363	-	-	32,460	-	-	830,084	830,084	-	-	-	-
Baytown, Tex.	856,840	386,304	470,536	256,240	286,304	470,536	-	-	-	-	-	-	-	-	-
Pensacola, Fla.	614,830	235,567	379,263	323,183	37,900	285,283	-	-	-	283,871	197,667	86,204	7,776	-	7,776
Key West, Fla.	502,000	220,877	281,123	467,723	189,882	277,841	-	-	-	34,277	30,995	3,282	-	-	-
Gulfport, Miss.	417,688	158,727	258,961	276,427	26,527	249,900	-	-	-	139,461	132,300	7,261	1,800	-	1,800
Freeport, Tex.	371,376	200,247	171,129	287,417	195,959	91,458	1,736	-	1,736	82,223	4,288	77,935	-	-	-
Boca Grande, Fla.	162,751	-	162,751	162,751	-	162,751	-	-	-	-	-	-	-	-	-
Other Ports	1,087,651	450,319	637,332	333,703	48,040	285,663	626	360	466	737,882	401,919	335,963	15,240	-	15,240
TOTAL - Gulf Coast Ports	47,245,372	14,670,482	32,574,890	22,692,978	9,869,015	12,803,963	597,748	287,500	310,248	23,686,696	4,469,679	19,217,017	267,950	24,288	243,652
PACIFIC COAST PORTS															
Los Angeles, Calif.	20,088,980	3,835,191	16,253,789	3,732,411	525,269	3,207,142	6,005,851	850,094	5,155,757	10,147,777	2,434,648	7,713,129	202,941	25,180	177,761
San Francisco, Calif.	9,254,715	4,521,164	4,733,551	2,727,096	883,083	1,844,013	1,603,647	712,872	890,775	3,726,201	2,115,808	1,610,393	1,197,771	809,401	388,370
Seattle, Wash.	7,378,773	4,908,423	2,470,340	2,144,790	388,575	756,215	544,226	200,191	344,035	4,135,075	4,135,075	1,049,555	506,682	186,147	320,535
Tacoma, Wash.	3,798,112	2,383,363	1,414,749	925,008	333,618	591,390	324,139	19,901	304,238	2,401,382	1,922,851	478,531	147,583	106,793	40,790
Portland, Ore.	3,788,707	1,786,533	2,002,174	1,380,802	95,746	1,284,556	500,611	198,346	302,265	1,891,732	1,484,310	407,422	16,062	8,131	7,931
Port San Luis, Calif.	1,642,610	15,931	1,626,679	481,667	-	481,667	-	-	-	1,086,861	15,931	1,070,930	-	-	-
Everett, Wash.	1,437,188	805,900	632,288	140,323	1,516	141,839	233,871	1,783	232,088	1,044,780	801,482	243,298	18,214	1,119	17,095
Bellingham, Wash.	940,733	549,994	390,739	136,658	72,260	64,398	92,089	5,388	86,701	638,750	451,421	187,329	73,236	20,925	52,311
San Diego, Calif.	665,871	637,051	26,820	29,295	15,711	13,584	36,997	34,214	2,783	597,578	587,126	10,452	-	-	-
Aberdeen, Wash.	629,762	485	629,277	411,159	-	411,159	207,081	485	206,596	-	-	-	11,522	-	11,522
Oakland, Calif.	569,279	557,584	11,695	40,317	35,656	4,661	100,548	93,514	7,034	428,414	428,414	-	-	-	-
Anacortes, Wash.	440,321	359,792	80,529	147,278	22,986	124,292	31,461	-	31,461	250,243	229,685	20,558	11,339	5,815	5,524
Port Angeles, Wash.	292,230	180,864	111,366	71,634	58,577	13,057	23,277	1,211	22,066	186,033	121,076	64,957	11,286	-	11,046
Astoria, Ore.	272,461	89,481	182,980	163,648	17,842	145,806	19,313	414	18,899	79,516	65,287	14,229	9,984	5,938	4,046
Other Ports	13,345,133	5,940,247	7,404,886	430,624	34,664	395,960	263,287	33,905	229,382	12,599,627	5,869,501	6,730,126	51,595	2,177	49,418
TOTAL - Pacific Coast Ports	64,542,875	26,572,013	37,970,862	11,962,210	2,587,009	9,375,201	9,986,398	2,152,318	7,834,080	40,261,969	20,661,060	19,600,909	2,332,298	1,171,626	1,160,672
GREAT LAKES PORTS															
Duluth, Minn.	39,852,321	9,285,988	30,566,333	756,857	59,192	697,665	-	-	-	39,095,464	9,226,796	29,868,668	-	-	-
Buffalo, N.Y.	17,651,686	13,511,087	4,140,599	3,797,541	2,943,970	853,571	-	-	-	13,854,145	10,567,117	3,287,028	-	-	-
Toledo, Ohio	10,082,783	1,673,865	8,408,918	1,166,382	64,581	1,101,751	-	-	-	8,916,451	1,609,284	7,307,167	-	-	-
Cleveland, Ohio	9,558,739	7,798,700	1,760,039	1,345,851	268,412	1,077,439	-	-	-	8,212,888	7,550,288	662,600	-	-	-
Conneaut, Ohio	8,770,722	7,418,922	1,351,800	160,272	3,500	156,772	-	-	-	8,610,450	7,415,4				

Exhibits at American Marine Exposition

Modern Innovations and Practices in the Marine Industry Are
Prominently Represented at the 1925 Show

YEAR by year the American Marine Exposition tends to lose the character of a cross-section of the industry and to assume more and more the aspect of a convention, to which exhibits of the latest developments in the industry are added for the interest of those attending the convention.

This year's Marine Show at the 212th Anti-Aircraft Armory, 62nd St. and Columbus Avenue, New York, from November 9 to November 14, shows very markedly the effect of this tendency. There is a great deal that is instructive and much more that is interesting for visitors to the exposition, but those who go in the belief that they will there find themselves broadly in touch with shipping, shipbuilding, marine engineering and the allied businesses will be disappointed. What they will find will be exhibits of most of the modern innovations in this domain.

Of the technical exhibits no detailed report is necessary, because the general nature of the individual exhibits serves as a more useful guide to the latest trend of practice. The following summary is believed to be a comprehensive and correct outline of the technical exhibits.

In the center of the Sperry exhibit will be a gyro-compass, illustrating the numerous advancements made in the device since it was introduced several years ago. The company will show a two-unit gyro-pilot, which has been developed since the last marine show and will make its debut to the shipping public at this time. It combines the advantages of electric steering and automatic steering through the use of a simple lever and without a telemotor.

A visible air whistle will also be part of the Sperry exhibit, a chemical resembling steam being used to visualize the whistle. The new revolution indicator, to be mounted on the bridge of a vessel to show the speed and direction of rotation of the propellers besides the total number of revolutions, will also be on exhibition and the company will show searchlights and other devices.

The Davis Engineering Corp. of New York will exhibit a large number of their specialties under the Paracoil trade name, these including exhaust gas boilers.

Worthington features the cylinder, piston, piston rod and spray valve of the new double-acting 2-cycle engine, which has been in operation on a 30-day non-stop run and has also had a number of 10-day and longer period runs. So far, the engine has withstood several million revolutions under full load without distress or damage. The cylinder, piston and piston rod show practically no wear. These parts belong to an engine of the same double-acting type as the Worthington Pump and Machinery Corp. is building for the Shipping Board.

One of the latest Fairbanks, Morse Diesel type marine oil engines and equipment will be shown, consisting of a generating set, air compressor, motor driven centrifugal pump, and a reciprocating pump.

Walter Kidde & Co. demonstrate the Rich system of smoke detection and the Lux carbon dioxide fire extinguishing system through the use of a small ship model with various compartments which permit a visual exhibit of the devices in operation.

A presurite super-centrifuge used for the clarification of Diesel engine oil and a standard open type machine, normally used for the clarification of lubricating oil, will be displayed by the Sharples Specialty Co.

P. S. Thorsen & Co. of Brooklyn will exhibit standard insulation and its application, including the insulation of Diesel mufflers, exhausts, etc., required by high temperature. Part of the booth will be occupied by the Thorokote Products Co., which will show cements involving new departures in anti-corrosive coatings for all ship purposes.

The American Machine & Foundry Company will exhibit a complete line of direct engine driven and motor driven rotary pressure and vacuum pumps.

A Walker patent log registering the exact number of revolutions of each propeller and the average number of revolutions of all propellers, the direction of revolution, changes in direction of revolution, the exact distance traveled per minute, and the number of miles traveled will be shown by George Walker. This will be the first time the instrument has been on exhibition.

The Winton Engine Company will display a 6-cylinder Diesel engine and a single cylinder air compressor set. These are two of the latest Winton designs.

The exhibit of the General Electric Company will include a "below decks" motor of the new line, a searchlight and an air mail beacon, in addition to steam equipment.

The new vapor-tight fuel oil purifier and a regular type purifier for lubricating oil will be found at the booth of the De Laval Separator Co. The new vapor tight machine is equipped with closed connections at all inlet and outlet points and has gasketed cast aluminum covers which prevent the escape of vapor and make it possible to purify fuel oil at a temperature above its flashpoint.

Morse Dry Dock & Repair Company promises to surpass its exhibits of recent years. Included will be a unique display of oil-burning equipment, with a glass furnace to represent a Scotch boiler. Water, by means of a pump, will be sprayed into the furnace under pressure to represent oil as an illustration of the Morse oil burner in conjunction with the Morse air register. A lighting arrangement will give the oil spray a red tint. Full data on the conversion of steamers to motorships will be available at the Morse booth.

Electric marine galley and bake shop equipment can be studied at the exhibit of the Edison Electric Appliance Co. The company will feature its newest development in the marine field, consisting of a heavy duty electric marine range with sea racks. It is portable and can be knocked down for moving through narrow companionways.

The Northern Pump Co. of Minneapolis and the Hill Diesel Engine Co. will exhibit a combined unit, using a 2-cylinder Hill engine, directly connected through clutches and chain drive to a Northern pump, an I-R. compressor and a GE. generator. This is a special job for Diesel tugs. The companies will also show a Hill 4-cylinder marine propulsion unit and the latest models Northern pumps.

The electro-hydraulic steerer and electro-hydraulic windlass to be installed on Commodore Arthur Curtis James' yacht ALOHA will be at the booth of the American Engineering Co.

One of the Diehl electric absorption dynamometers, used to measure the exact power developed or absorbed by engines, transmissions, completed automobiles, and other rotating machines, will be shown by the Diehl Mfg. Co., together with examples of its marine type electric motors.

The model of a stern of a vessel on which can be fitted about six types of detachable contra-propellers, and an aluminum model showing every detail of a standard six-bladed contra-propeller, will be displayed by the Th. Goldschmidt Corporation, in addition to a model of a Flettner rudder, comprising part of the stern frame and the rudder with operating gear.

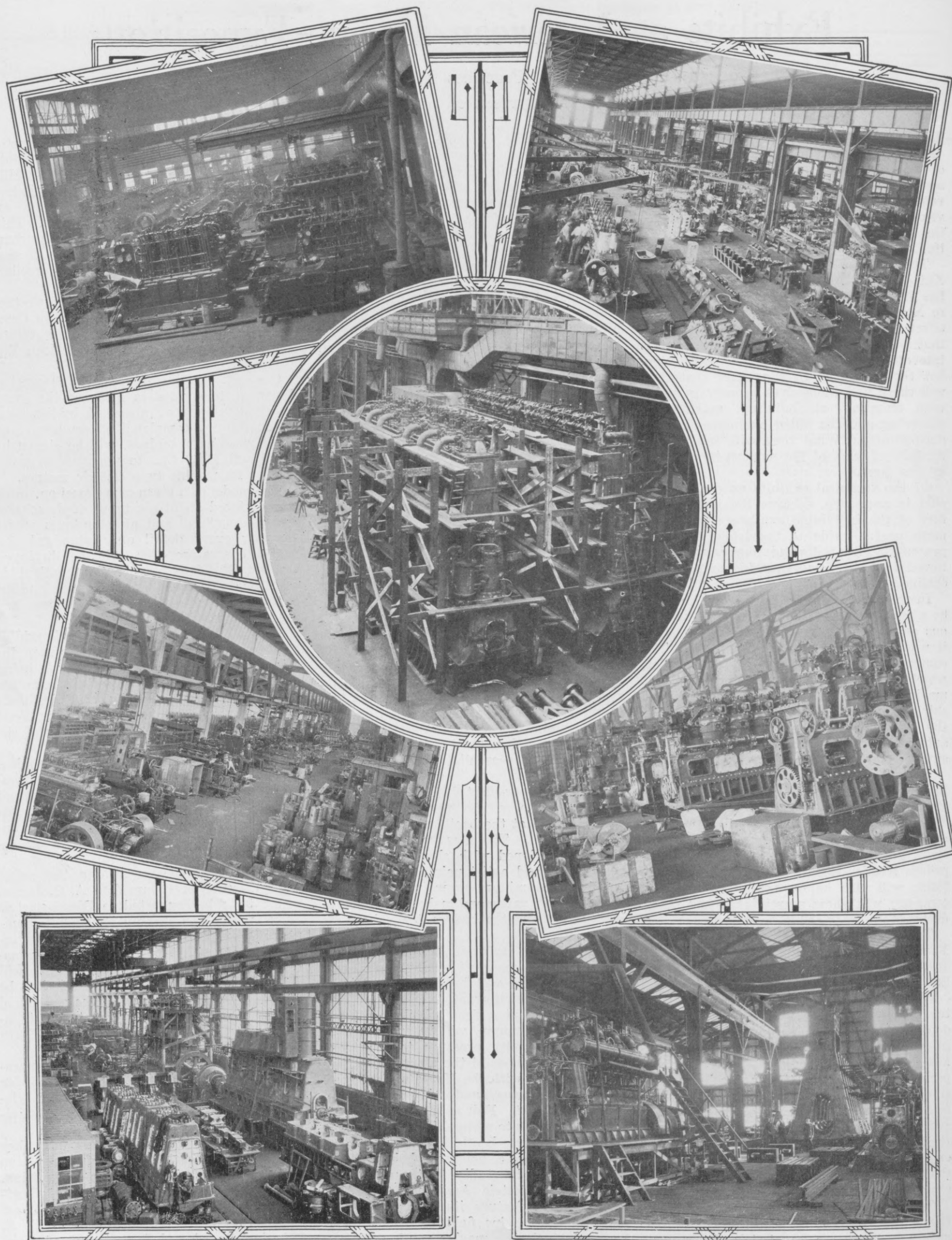
Todd Shipyards Corporation will exhibit the new Todd rotary fuel oil burner for low pressure installations, which is being shown for the first time. Other exhibits will consist of the Todd natural draft air register for marine and power plant, Todd Marine Lamps and an A. R. Welder of the portable type.

A new Diesel engine that is crankless and valveless, eliminating wrist pins, connecting rods, and many minor parts of standard engines, will be exhibited by the Crankless Engine Co. The power is applied directly from the pistons to an oscillating or wobble plate.

The electric equipment for the yacht ALOHA, owned by Commodore A. O. James, which is to be converted to Diesel-electric drive, will be on display by the Westinghouse Electric & Mfg. Co. This will include a 640 hp. Westinghouse double armature propulsion motor. The exhibit will also comprise the pilot house control to be used to regulate the speed of the motor and a dead front switchboard for the installation, as well as the generators and exciters for connection with the Winton engines.

A hydro-electric steering gear in operation and a Hyde electric telemotor, rudder indicator and electric engine order telegraph and reply will represent the activities of the Hyde Windlass Co.

All the Government departments that possess any important fleet of boats have sent exhibits to the Marine Exposition. From the Bureau of Lighthouses, Engineers Corps of the War Department, Coast Guard Service, Navy Department, U. S. Shipping Board and Department of Commerce displays have been furnished representing the marine activities of these services.



Activity Prevails in the Marine Oil Engine Works

Illustrations on the left from top to bottom represent part views of the erecting floors at the Bessemer-Atlas, Atlas-Imperial and Busch Sulzer works, respectively. On the right from top to bottom are similar views in the Winton, New London and Pacific Diesel shops. Inset is a picture of engines on the floor of the American Brown Boveri Electric Corporation's plant at Camden, N. J. These views were all taken last month.

Report on the American Merchant Marine

Replacement of Present Merchant Ships, Sea Trade Conditions and the American Merchant Fleet

By Rear Admiral W. S. Benson*

IN facing the shipping future of the United States there are but two points of view:

(a) That the United States shall encourage and develop American ships and shipping, already started, so that this country—a natural maritime nation with over 5000 miles of coast—will possess an adequate merchant marine and take its due place in the economic development and possibilities of international trade; or

(b) That we abandon the mercantile seas as rapidly and economically as possible and let who will carry goods to us or from us as cheaply as may be done, or as expensively as will be done in the absence of adequate competition.

With the period of the Civil War our shipping was destroyed—some form of basic economic destruction is always one of the penalties of war. And, then too, the days of sail were over. The day of steel ships was arriving. In Europe they had the great iron industries; they were better equipped to fabricate iron and steel ships than we were. And wooden ships with sail could not compete with iron and steam. So shipbuilding passed across the water away from us as our own yards decayed. But we did not trouble ourselves, at that time, for in our West stretched an ocean of prairie; and we turned American energy to building a broad nation and trading with its newly growing domain. Today railroads net-work the country so completely that the railroad days of enterprise and development are past; it is for the future chiefly a problem of railroad upkeep and feeder development to trunk systems.

Apparently, in the development of civilization, economic progress marks itself in fairly distinct waves, sometimes overlapping, but always each with a fairly definite outline of its own. We are still in the great age of invention—and at the same time there is a developing economic system that is bringing the world closer together and more inter-dependent. So, as we realize the completion of the pioneer railroad era, it is reasonable and highly important that we scrutinize the field for our next great and comprehensive economic development.

Our Next Development is at Sea

It would seem natural and inevitable, unless it meets with artificial hindrance, that this next comprehensive economic step will be on the sea, not only by reason of our traditions and the natural instincts of a nation with a huge coastline and great internal productivity, but because there is on the sea a great field for transportation enterprise and the development of a commerce profitable for both the producers ashore and for the transporters on the sea. We are a great producing nation with a vast interior and coast production centers; a wonderful system of access to our splen-

did ports, a geographical position on the globe that, given these advantages and our economic development as it is, means that we must sell more abroad and, as a consequence, buy more from abroad. This means a merchant marine with cargoes both ways—for ships cannot steam empty one way and full the other with profit to themselves or their own nation.

Nor does the development of an American merchant marine—or rather its redevelopment—mean that the amount of wealth for sea transportation is a fixed quantity and that this nation cannot develop on the seas except at the expense of other nations. There is no fixed volume of wealth in the world upon which nations must prey or go without; the resources of the world are limitless, and trade grows and the wealth of peoples increase as they develop the production and diffusion—or transport—of wealth.

The globe and its contents is our antagonist; there is wealth there for all and the view is fallacious and demoralizing that nations can only achieve by preying upon each other's commerce. Wealth is the reward of productive development. The sea trade of the future, certainly as affecting our national policy, will be along the lines of the development of new wealth—sometimes raw wealth and sometimes wealth advanced in manufacture—and new expansions of trade with foreign peoples. The wealth producing power of the world is increasing, and so is its potential for wealth consumption. And this wealth consumption is, to great extent, simply wealth that is not consumed in the sense of being destroyed, but simply wealth used in the production of more wealth. Trade grows with the development of uses and desires, and in a survey of the field of development of an American merchant marine there are some of the factors to be considered.

It is true, for the moment, that international trade is suffering from the destruction caused in the Great War together with the loss or disorganization of great areas of peoples whose consuming power has been severely injured. This condition is temporary; all over the world there is restlessness that may, in its economic aspect, be traced to the fact that many peoples are desirous of becoming greater consumers of the wealth and delights of higher and more comfortable civilizations. And this restlessness for new adjustments—quite as much economic as political—will organize itself with a rapidity greater than it is easy to realize at the moment—and there will be as a natural, inevitable and normal result, a sea-trade calling for transportation for which the business enterprise of this country should be adequately prepared in merchant marine development.

And, not only is an American merchant marine necessary for the carriage of a fair proportion of our exports and imports but it forms a vitally important arm of our

national defense. Until navies are abolished altogether it cannot be gainsaid that an efficient merchant fleet is an auxiliary transport of the utmost, in fact, vital importance. And in time of peace it not only serves a useful economic purpose without waste, but it also provides a continuous training for officers and men that gives the nation a reserve personnel, expertly trained in the operation of ships, that can be called into being as a naval force of enormous potential in any time of national emergency. For a specific illustration one may cite the vital functions that aeroplane transport ships will perform in the future. Yet merchant ships can be, and have been, effectively designed for all the uses of peaceful trade in time of peace, yet readily and quickly convertible as aeroplane carriers when an emergency arises. There is no economic loss in this line of preparedness.

In the development of an American merchant marine an economic survey of the trade of the world indicates three major fields of ocean carrying trade in relation to this nation, i. e. (a) the sea trade of the Atlantic between Europe and the United States; (b) the sea trade of the Pacific with the Orient, and Australia; and (c) the sea trade and the continent of South America in both the Pacific and Atlantic Oceans.

The European Sea Trade

(1) The Atlantic-Europe sea trade is highly competitive and well developed with a large volume and ratio of highly profitable passenger traffic. All of this produces a situation that must be frankly analyzed, and recognized, in considering the development of European sea trade on this ocean. The already entrenched and large capital invested in this sea trade and controlled from Europe makes a formidable competitor that must be met with adequate resources and fully competitive equality. This should be done and, so far from abandoning the substantial start already made this initial step should be expanded to become the normal, customary balanced unit for a trans-Atlantic fleet.

There is an economic unit of fleet operation as well as for any other operation of industry. The United States Lines fleet is away below this economic unit of a balanced fleet as evidenced and proved by comparison with the existing successful, dividend paying Atlantic trade. To be below this economic unit of a balanced fleet means that the heavy overhead of operation must be concentrated in a disproportionate overhead charge upon a single part of a unit.

Comparison with the best and shrewdest ship operators in the Atlantic-European trade shows that their balanced fleet unit consists of a basis of three high-power, high-speed, first class passenger vessels and then a number of subordinate vessels. But the United States Lines have but one vessel in such a class, the LEVIATHAN, and that

*U. S. Navy (Retd.), Commissioner U. S. Shipping Board.

ship has to carry an overhead that should be proportioned—simply as a matter of established business principles, to say nothing of any national factors of pride or sagacity—among two other vessels of high class.

Without going into too elaborate an analysis of the ocean trade it may be added that, aside from the present unbusinesslike, but unavoidable, method of charging a disproportionate overhead to a single subnormal economic unit, there are enormous collateral advantages in the three-ship principle through advertising values, frequency of highest class service, and national pride in a businesslike method of developing an ocean carrying, merchant marine trade in the Atlantic. It is, however, not necessary for this report to argue a case for the three-ship basis as a means of developing our Atlantic merchant marine since this three-ship basis is a proven and developed principle regularly adopted by the most successful ship operators that are already established in this Atlantic trade. Moreover, whether this Government fleet is admittedly unsuitable and inefficient to meet the competition it meets in the Atlantic trade as it stands, but also, if it is to be sold to private enterprise, it is, by reason of its present unbalanced inefficiency unsuitable for a sale of any advantage to the Government. We have established, in effect, a half-built, unbalanced fleet machine for ocean transport; to abandon it means reckless waste, to finish it and make an effective machine is economy in the end, whether the Government keeps it or sells it to private operators.

Therefore, since the fleet of the United States lines in the Atlantic is already an accomplished and operating fact we believe, simply as a matter of ordinary and prudent business principles, that it should be built up to the accepted standard of a three-ship basis and appropriate provision made for replacements to take care of deterioration and obsolescence as well as to balance the fleet in a normal business way in view of the competition it meets and the trade conditions it serves. Two ships, modern motor-ships, of the general class of the *GEORGE WASHINGTON* should be added at once so that together with the *LEVIATHAN*, a regular high-class service may be maintained similar to the standards in accepted usage and to meet the needs of that service. These ships should be built with the view of their possible and ready conversion as aeroplane carriers in time of emergency. And all of this entirely distinct from any question or policy of Government ownership or operation, now or subsequently, for this fleet must be balanced and have provision made for replacement whether in Government hands or private hands.

The Sea Trade of the Pacific

(2) The sea trade and the development of an American merchant marine on the Pacific presents a somewhat different aspect than that of the highly competitive field of the Atlantic. In the Pacific we occupy, naturally, and by reason of our geographical position on the globe, a situation of great advantage to the development of a merchant marine in those seas.

There are two great manufacturing areas, or centers, in the world; Europe and the United States. The manufacturing centers draw upon the whole world for

raw materials and, as they draw and send forth, so is sea trade borne and developed. Along the lines of least sea transport will sea trade most easily develop. In other words, where the reciprocal markets are closest, geographically, there will sea trade most easily develop.

It is obvious, from a glance at the map, that the Orient is closer to our Pacific coast than it is to Europe, and by a very great margin. This means less steaming in both directions with cargoes, and also a natural geographical differential in favor of American trade with the Orient that is, or should be, a point of most earnest and thoughtful consideration for the future—both the near future and the general future—for it has a very definite potential for our Pacific and Western and mid-Western States. From the Orient or Australia to the Atlantic seaboard of the United States is practically the same distance as from Europe to the Orient and Oceanica. So that the Pacific Coast has a very great natural advantage in the development of trade with the Orient and Oceanica; and the Atlantic seaboard at least an equal opportunity, geographically speaking, with Europe.

Inevitably the Pacific coast and west of the Mississippi generally must feel the effect of intelligent development of Oriental trade since they are likely, in the normal economic progress along these lines and in the course of time, to develop manufacturing industries for themselves instead of allowing raw wealth to be shipped by rail across the country to the factories of the East and; in fact, to bid for this Orient trade against the sea transport to the Atlantic seaboard or Europe.

Another highly important factor to be considered in this sector of the development of an American merchant marine is the consuming power of the area at the other end of the sea-borne trade. This consuming power is important for, in the last analysis, goods must be paid for in goods, and return cargoes are quite as important as outbound cargoes. The outbound cargo is only one-half of the story.

This consuming power is dependent upon the quantity of population and its own wealth-producing powers and production to pay for the outward bound cargoes; and also, upon its density. Thus it is important and easier to develop trade with a country whose peoples have in general, and spread throughout the mass, desires for merchandise necessities and luxuries—and have reached a sufficient advance in economic civilization to enable them to produce wealth to pay for these desires. There is little here in trading on a large scale, such as the development of an American merchant marine means, with sullen submerged, inactive or sparse peoples. The poverty of the mass of the Orient is offset by density and vast quantities of its population; and also there is a reason for the general belief that it is shaking off what we have regarded as a supine, submissive fatalism in the mass and that there is impending a vigorous economic as well as political awakening that the business and producing interest of this country cannot ignore and should not ignore.

It is a market for trade and shipping that has a tremendous and active potential. By reason of the natural location of this continent on the globe American business

has before it in the Orient and Oceanica an opportunity for a trade, and shipping, that stirs the imagination. But this opportunity, now in the stage of laying its foundations, cannot be developed by imagination alone. It needs ships. And in this connection it might be mentioned already there is being built the largest, high-powered ship ever built in this country and which will ply on the Pacific.

The Sea Trade with South America

(3) In the field of South American trade there are two natural divisions that should be considered separately as relating to the sea trade of this country, i. e., the east coast and the west coast of that continent. The east coast sea trade of South America is, generally speaking, substantially the same sea distance from Europe as it is from New York or New Orleans and thus this country has no natural geographical advantage in relation to the South American trade on the east coast.

This country has, however, a natural geographical advantage on the west coast over European sea trade. This long coast is noted for its few harbors and the great wealth of mineral that lies in the vast Andean range whose mountains come down almost to the line of the Pacific surf. This west coast of South America is a very appreciably shorter distance to the United States than to Europe.

So that our sea trade with the east coast of South America is substantially on the same natural basis as that of Europe and only on the west coast is there a natural and shorter sea distance in favor of our sea trade. The sea distance to markets south of the equator on the west coast of South America is fairly approximate to the distance of the ports of Asia from the United States Pacific Coast. In place of the densely populated Orient, however, South America—on its west coast—offers a sparsely settled area and, in the great mass of its sullen, subjugated, Indian population that is, or has sunk, far below its predecessors from the economic viewpoint of either production or consumption, the question of the development of sea trade is then involved with the problem of stimulating or organizing a sparsely inhabited but large area as an economic factor. The great mineral wealth of that coast will furnish cargoes, but the sea trade problem must deal with the factor of adequate cargoes both ways if sea trade is to develop profitably. This trade will reopen naturally in the ordinary course of time, but it is hardly ready for any concentrated development.

On the east coast with the sea distance substantially the same from this country as from Europe the competition in selling will be keener and the sea trade dependent entirely upon commercial salesmanship to furnish the cargoes of exports to that coast. The situation in regard to the sea trade of this coast is not essentially different in principle—with the exception of the pressure of passenger carrying and general volume—with the position of our sea trade in the North Atlantic direct with Europe.

Essence of Our Sea Trade Problem

The very essence of the whole problem of the development of an American merchant marine lies in the building of American ships. And this question must be

met, frankly and boldly, and a solution found. Americans can build splendid ships—our splendid American built Navy proves that.

But American merchant ships cannot be built as cheaply as can the ships against which these American ships must compete in the sea trade of the world. Nor is this a question of the cost of operating the finished ship for as to this field the United States can well feel proud that it has taken a step forward in civilization when she passed laws that abolished abuses of the sea and abuses against the laborers of the sea on American ships; abuses against natural human rights that had existed so long that they had become crusted with sanctity. In no other field of economic endeavor, in civilized countries, had abuses—virtual peonage and chattel slavery in all but name—continued and sanctified under medieval legal principles as they had upon those who followed the sea as common seamen. Nor was it fair that Americans should ask American seamen to accept as fair competition in their trade competition with the lowest, most ignorant and backward elements or peoples—often still in their tribal stage—in the world. The sea is a splendid calling, dignified by its dangers, and a vital factor in any great nation; and the men who follow it are entitled to protection, not only against its traditional abuses, but against the effort to keep his wage or conditions in competition with the pittance of the tribal flotsam of the Pacific or the degraded standards of a submissive, unthinking, lower crust of lower or less developed peoples.

An American merchant marine should not be, and must not be, built up at the expense of the American manhood which we ask to handle it.

In other words, in the development and building up of an American merchant marine we must frankly accept the conditions of cheaper costs for ships abroad so that a heavier capital expense is immediately charged against an American ship owner, or prospective owner. We must put no portion of this adverse differential upon the backs of American seamen nor drive them ashore so that their jobs may be given to the coolie classes of any peoples. But, if we are to exist as a trading nation we must have our fleet upon the seas, together with such appropriate legislation as will keep it there for our national advantage as a great commonwealth in the world of today and the world of the future. For our trade future and the trading abroad of our surplus production, depends in large measure upon our proper shipping facilities and the existence and availability of an American merchant marine.

Analysis in Detail

Under the foregoing general conditions and potential of sea trade it is necessary to consider in detail the present condition of American shipping with the necessary problems of development, upkeep, replacements and the various factors that make up a modern merchant marine.

Before proceeding along this line it will be well to note the following tabulation of the tonnage of vessels by countries of vessels of 12 knots speed, or faster, and of over 6000 tons.

The table indicates the present great inferiority of the United States.

Comparison of Tonnage of Vessels by Countries

Over 12 Knots and over 6000 tons

TONNAGE	GT. BRITAIN	U. S.	FRANCE	JAPAN	GERMANY	OTHERS	TOTAL
Over 25,000.	8	1	1	..	1	..	11
20,000-25,000	13	2	1	..	3	2	21
15,000-20,000	42	6	..	..	1	8	57
10,000-15,000	117	28	17	12	10	24	208
8,000-10,000.	165	17	25	10	15	49	281
6,000-8,000..	318	44	30	51	18	112	573
	663	98	74	73	48	195	1151

At the present time the fleet carrying on our foreign trade is made up of a majority of Government owned vessels operated by the Fleet Corporation. Within the last year, however, energetic attempts have been made to dispose of the Government fleet to private interests and some progress has been made, notably the sale of round-the-world and Pacific ships to Dollar and the sale of the fleet of steamers operated by the Export Steamship Corporation to the operator. It is apparent that if this policy is continued, the number of vessels operated by the Government will decrease and the number operated by private interests will increase; but in any case, the vessels being operated are the same and unless measures are taken for the replacement of the vessels as they become unfit for use through depreciation or obsolescence, the American ships in the foreign trade will once again become but a memory.

As stated in a preceding paragraph, it is well recognized that the shipping situation throughout the world has reached unprecedented depths of depression. This has come about through the disorganization of trade, not only in Europe but trade in general, resulting from the war conditions and it cannot improve until Governmental stability and restoration of the financial fabric takes place among the nations of the world so that trade may be resumed. We are inclined, after reading the reports of the losses incurred in the Government operation of the American ships in the foreign trade, to feel that the unfortunate result is due entirely to Government operation, but while it is admitted freely that Government operation is not and cannot be as efficient or desirable as private operation, at the same time, it should not be forgotten that the reports of the foreign steamship lines and the pronouncement of their operating officials indicate that the shipping industry of the whole world at the present time is unprofitable and, as a result, great fleets of vessels are tied up, no business being available to keep them employed.

The gradual increase in foreign trade—which is to be expected from the increasing stability and reorganization of Government finance now going on in Europe—as it increases will make the employment of vessels more profitable and require an increase in the present operating fleet to take care of the increase of trade.

It is fair to assume, therefore, that the American ships, which are operated in the foreign trade at the present time in both passenger, passenger and cargo, and cargo

services, are approximately a minimum, necessary to handle a reasonable proportion of our exports and imports and thus meet the announced principles of this country "that an American merchant marine in the foreign trade is necessary."

Present Active Tonnage is Minimum

As noted in the preceding paragraph, we feel that it is safe to assume that the present fleet in the foreign trade, being operated by the Government and private individuals, is a minimum to meet the requirement that a reasonable proportion of our exports and imports should be carried in American vessels. It is true at the present time that a large proportion of this foreign trade is moving in Government owned vessels. With the exception of the Government vessels recently purchased by the Dollar interests and the Export Steamship Corporation, privately owned American vessels are only being operated in relatively small numbers on the various foreign trade routes, principally to South America and the Orient (for the purpose of this discussion, we will exclude the trade with the West Indies which will naturally flow to us by reason of our geographical position and which it is hardly fair to include in the term "Foreign Trade," in the sense that it is used herein, namely: "World-Wide Trade"). In order, however, to be amply conservative, we will assume that the combined fleet of Government operated vessels and those operated by private firms, necessary to handle a reasonable proportion of our exports and imports, equals the Government operated vessels and those purchased recently from the Government. This is true with one exception, namely that the passenger and cargo fleet in the north Atlantic will have to be balanced by the construction of certain vessels as dealt with elsewhere in this report. In other words, let us assume that the minimum fleet comprises the vessels at present operated by the Government plus those purchased by Dollar and the Export Steamship Corporation. It would be well to examine the particulars of this fleet and the replacement required under the two categories, (1) passenger and cargo vessels and (2) cargo vessels.

At the present time the fleet of passenger and cargo vessels, including those owned by the Government and those sold by the Government to Dollar, comprise 27 vessels with a gross tonnage of 421,294 and an average age of six years.

There can be no doubt that the vessels referred to are a minimum to properly carry on our trade, at present, in cargo and passengers on the routes over which they are now operated. In the case of the passenger and cargo vessels on the North Atlantic particularly, it is glaringly apparent, for this North Atlantic is a sea trade in which more American passengers are carried than all the other nationalities combined—an ocean carrying trade, in fact, in which the American passengers far outnumber the foreigners, yet it is in this very North Atlantic Ocean in which our American fleet is hopelessly inadequate.

The vessels operated by the United States Lines comprise the most unbalanced fleet of passenger and cargo vessels in the world.

It is physically impossible to give with this fleet a passenger and cargo service

which compares in frequency and regularity of sailings and type of accommodation to that provided by the great foreign lines of other countries.

If our American merchant fleet service in the North Atlantic is to be brought up to a reasonably competitive position, it is vitally important that two economical combined passenger and cargo vessels of at least twenty-knots sea speed be constructed to operate in conjunction with the LEVIATHAN to British Channel ports, thus providing a weekly service under the American flag for the transportation of mail, passengers and cargo.

The construction of these two additional vessels, to enable us to operate on the customary trans-Atlantic three-ship basis, is not adding to our fleet any more than is an automobile maker "adding" to an automobile when he adds two more wheels to the two already on.

Without such addition there is no complete unit of effective operation; with such addition a going, effective, competitive machine is completed.

If this three-ship basis were not sound and a proven principle of successful North Atlantic fleet operation it would never have been developed and maintained by the shrewdest ship operators of European maritime affairs.

Big and Fast Motor Liners

These two vessels should be of approximately 30,000 tons each, with internal combustion engines giving a speed of about 20 knots, designed so as to be convertible into airplane carriers with accommodations for a large number of passengers, and a cargo capacity of about 6000 tons. Two ships of this type with the LEVIATHAN would complete the standard three-ship basis and would make competition on an even basis—a basis in our favor, in fact—and would show substantial profits from operation. So that if the Government continued to operate it would be at a profit instead of a loss or, if it wished to sell, it would have a complete transport unit to sell.

It should be recalled, in considering this subject, that these are passenger vessels and there is no reservoir of laid-up fleets from which can be drawn at will vessels to supply any deficiencies.

Moreover, as noted above, unless measures are taken looking to the replacement of these vessels—whether they be owned by the Government or private individuals—the time will come when they will be worn out and scrapped; and nothing will be available to take their place.

The average age of the vessels under consideration is 6 years. Assuming that the life of the vessels is 25 years and that another three years must elapse before any replacements can be constructed and put into operation, the replacement of the fleet will have to be accomplished within a period of 16 years which will require the construction of about 26,000 gross tons of passenger vessels per year. This is in addition to the construction of the two combined passenger and cargo liners required for the North Atlantic service which should be of at least 30,000 tons each. This addition, therefore, means the construction of an average of 30,000 gross tons of passenger vessels per year during the period from 1928 onward.

Cargo Vessels and Replacements

As of July 31st, 1925, the Government operated cargo vessels distributed among the various operators numbered 231 vessels of about 2,000,000 total deadweight tons in operation.

It is safe to assume that the average useful life of a cargo steamer is approximately twenty years. It is also safe to assume that the average age of these vessels is at least seven years and that three years will elapse before any replacement vessels can be authorized and constructed and it is apparent, therefore, that the 2,000,000 tons will have to be replaced during a period of 10 years or at the rate of 200,000 tons per year. It is true, of course, that a certain number of these vessels may be replaced with vessels of the Government now laid up, but, at the same time, it should also be remembered that the Government fleet as a whole was constructed during an emergency and, due to the inexperienced operation and the long periods of lay-up, it is safe to assume that the value of the vessels, whether withdrawn from lay-up for replacement to the operating fleet, or operated continuously, will not exceed a period of over 20 years.

However, in considering this subject, it should never be lost sight of that we are in direct competition with skilled foreign operators. Thus it will be found that, in connection with vessels on the long voyage trades running to the Orient and in connection with vessels on the North Atlantic, that we are forced to compete with the cream of the British, German and Japanese merchant marines and that our competitors on the important liner routes are operating the highest type of cargo liners and are adding thereto.

It is the considered opinion of nearly all who have investigated the subject closely that the possibilities of successful American competition in connection with overseas shipping rests in the development of the cargo liner as opposed to the tramp type of steamer. Speedy transport of commodities as an inducement to shippers is essential and it is, therefore, apparent that, first, as an inducement to American shippers, the speed of our cargo liners should be enhanced and, second, to enable them to successfully compete with the highest type of speedy ships of our competitors, the speed of our vessels would have to be increased. In considering, therefore, the necessary replacements in connection with the cargo fleet now being operated, it would seem sound to limit such replacements to cargo liner types of vessels with a speed of at least 14 knots and a total deadweight of carrying capacity of not less than 11,000 tons. We can safely assume that at least one-half of the trades on which Government ships are now being operated will require the cargo liner type of vessel.

Ten-Year Shipbuilding Program

In view of the fact that we have no vessels in the Government fleet which correspond to the true cargo liner as outlined above, it is apparent that we should concentrate on building a considerable number of these vessels to the exclusion of the smaller and slower ships which may be provided out of the reserve of vessels laid up for the time being, thus enabling us to concentrate on a higher and better type. To replace the cargo fleet of 2,000,000 tons

in operation during a period of ten years would involve the construction of 200,000 deadweight tons per year. There is no doubt that during the first few years of any replacement program, this figure of yearly replacement should be reached or exceeded, in order that the cargo liners may as rapidly as possible supersede the less efficient and desirable vessels on the various foreign trade routes.

As previously referred to, the Government vessels are being sold to private interests. Any plan, therefore, which contemplates the replacement of the present fleet should enable the vessels to be built by private interests, as well as by the Government. It is obvious that some method of equalizing the cost of building vessels in this country with the cost of constructing them abroad will have to be found to enable these vessels to be constructed in the United States.

At the same time, it may be found that in the case of certain of the lines which will have to be retained for the time being by the Government, it will be necessary for the Government to order the replacement vessels itself.

In any case the important thing is "that the vessels must be replaced" and that this minimum fleet which we are operating be not allowed to vanish from the seas.

Conclusion

From a consideration of the preamble outlining the arguments for an American merchant marine, the announced policy of Congress and the announced policy of our people, it is assumed that we should have an American merchant marine in the foreign trade. It is the only way that we can properly protect our foreign trade during the intensively competitive period which will be inaugurated with the resumption of world trading on a large scale. An American merchant marine is necessary to form a vital reserve of ships and trained personnel against any time of national emergency. It is apparent that the minimum fleet required to accomplish this may be safely measured by the Government fleet and vessels purchased from the Government now in service, together with the construction of two 30,000 ton, 20 knot cargo-and-passenger-liners, readily adaptable for airplane carrier conversion to balance the fleet on the North Atlantic.

It is apparent that replacements will have to be made or our fleet will rapidly depreciate and finally vanish from the sea, after, during the latter part of its life, having been entirely unable to compete with the foreign lines because they, as a customary and sound business policy, replace their less efficient tonnage with the larger and faster cargo liners.

It is, therefore, recommended that the construction of at least 30,000 gross tons of passenger and cargo vessels be undertaken each year and the construction of at least 200,000 total deadweight tons of cargo liners be undertaken during each year.

It is believed that before this replacement program is far underway, world conditions will improve so that the demand for an increased program will justify the construction of a considerably augmented program. Certainly, the program as outlined above is a minimum and merely consistent with maintaining our present position in the shipping world.

Progress of U. S. S. B. Conversion Program

A Review of the Work Accomplished in Providing the Equipment for 14 Large Motor Vessels

NOW that the Diesel program of the Shipping Board has progressed to the point where several of the engines are approaching readiness for their 30-day tests, it is possible to look back on the work that has been accomplished.

The impelling motives for the Government entering into this program were two—that has been accomplished since a start was made.

- 1st: Recognition that vessels propelled by internal combustion engines were destined to be the economical carriers of ocean trade in the future, and
- 2nd: Recognition of the fact that American industry had not kept pace with foreign countries in this development of engine design and was being left far behind.

The plain, primary duty of the Shipping Board is to promote the interests of an American merchant marine. It was conceived that in this particular direction this duty could be accomplished in two ways by the same act.

- 1st: By adding to the merchant marine a number of units recognized to be so economical of operation as to be worthy competitors of any vessels that other nations might place upon the seas, and
- 2nd: To promote the development of the industry of the country engaged in manufacturing and installing Diesel plants, by giving such impetus as appeared only within the power of the Government to give.

Pioneering of any nature is generally not of itself an economic proposition, unless viewed as it affects the future success of the subject as a whole. Thus, it may be stated that the present Diesel conversion program is hardly an economical move in itself. But recognizing the fact that the degree of success of this particular undertaking will weigh heavily in determining the future of Diesel ships as an American product, every possible precaution has been taken that the initial ships be converted at a cost that will justify the case of the Diesel ship.

After most careful deliberation of all features pro and con, the decision was made by the Shipping Board to purchase all engines and auxiliaries and then enter into contract, after competitive bids, with competent shipyards for the dismantling of the steam plants in the vessels and the installation of the new engines and auxiliaries. In reaching this decision advantage was taken of the fact that in purchasing large lots of materials, cheaper prices would be secured. This position has been fully vindicated by the results of the bidding. Also, the Government desired to retain some control as to the distribution of this work where it might result in the widest development of the industry. In this connection it is interesting to note the widespread location of the contractors for the materials, spread across the country from Boston to Oakland, Cal.

MAIN ENGINES

Worthington Pump & Machinery Corp.,
Buffalo, N. Y.
McIntosh & Seymour Corp.... Auburn, N. Y.
Hooven, Owens, Rentschler Co... Hamilton, O.
New London Ship and Engine Building Co.,
New London, Conn.
Busch-Sulzer Engine Co..... St. Louis, Mo.
Pacific Diesel Engine Co..... Oakland, Cal.

AUXILIARY ENGINES

Pacific Diesel Engine Co..... Oakland, Cal.
Worthington Pump & Machinery Corp.,
East Cambridge, Mass.
McIntosh & Seymour Corp.... Auburn, N. Y.

THRUST BEARINGS

Kingsbury Machine Works... Philadelphia, Pa.

75 KW. GENERATORS

Ridgway Dynamo and Engine Co.,
Ridgway, Pa.

MOTORS AND CONTROLS

Westinghouse Electric and Mfg. Co.,
Pittsburgh, Pa.

BRAKES

Cutler-Hammer Mfg. Co.... Milwaukee, Wis.

STARTING AIR TANKS

Moore Dry Dock Company..... Oakland, Cal.
American Brown Boveri Corp... Camden, N. J.
Newport News S. B. and D. D. Co.,
Newport News, Va.

CARGO AND WARPING WINCHES

Lidgerwood Mfg. Co..... New York

PUMPS, WATER AND OIL

Nash Engineering Co... South Norwalk, Conn.
Kinney Mfg. Co..... Boston, Mass.

ELECTRIC CABLE

Standard Underground Cable... New York City

MOTORS FOR UNDER-DECK AUXILIARIES

General Electric Co..... Lynn, Mass.

SHAFTING

Newport News S. B. & D. D. Co.,
Newport News, Va.

EMERGENCY AIR COMPRESSORS

Mianus Diesel Engine Co... Bridgeport, Conn.

SWITCH AND CONTROL BOARDS

Walker Switchboard Co..... Philadelphia

A brief description of the major structural work, aside from machinery installations, necessary to convert the steamers to modern motor vessels, is about as follows:

1. Removal of all machinery, steam piping, steam deck winches, steam engines of windlass and steering gear, settling oil tanks, foundations, screen bulkheads, etc.
2. Extensive stiffening of inner bottom structure in way of the old boiler and engine room, to take care of the heavy concentrated loads of main engines and auxiliary generating sets. These vessels are longitudinally framed, and considerable additional transverse structure is necessary to distribute these loads.
3. Build strong and rigid foundations for all new auxiliaries.
4. Remodel and extend machinery to form a continuous space. Provide structures to maintain strength after removal of portion of decks, bulkheads, etc. Build house for muffler and stack casing.
5. Raise propeller shaft line to parallel with keel in order to give sufficient depth of girders over tank-tops.
6. Remove culinary fresh water tanks from engine room to upper deck.
7. Remove all electric wiring and fixtures and replace with new, suited for 230-volt current.

tures and replace with new, suited for 230-volt current.

8. Build sump tank for lubricating oil, in inner bottom, also foundation and supports for starting air tanks.

9. Arrange new fire-smothering system for cargo holds and machinery spaces.

10. Shift crew's quarters from fore-castle to a new house on poop deck, to give more comfortable and accessible quarters, and provide additional space for cargo.

11. Rearrange and extend present accommodations amidships to allow for 11 passengers and provide for service to be maintained with least possible complement in stewards' department. All feeding is done in midship house, with service direct for galley. Change coal range to oil-burning. Remove steel boat-deck in quarters and lay wood deck. Provide additional ventilation for service in tropics. Relocate dry stores compartment. Provide additional refrigerated 2-ton capacity on account of long voyages. Enlarge wheelhouse to provide chart-room.

12. Provide heating coils in deep tanks for heating cargo oils.

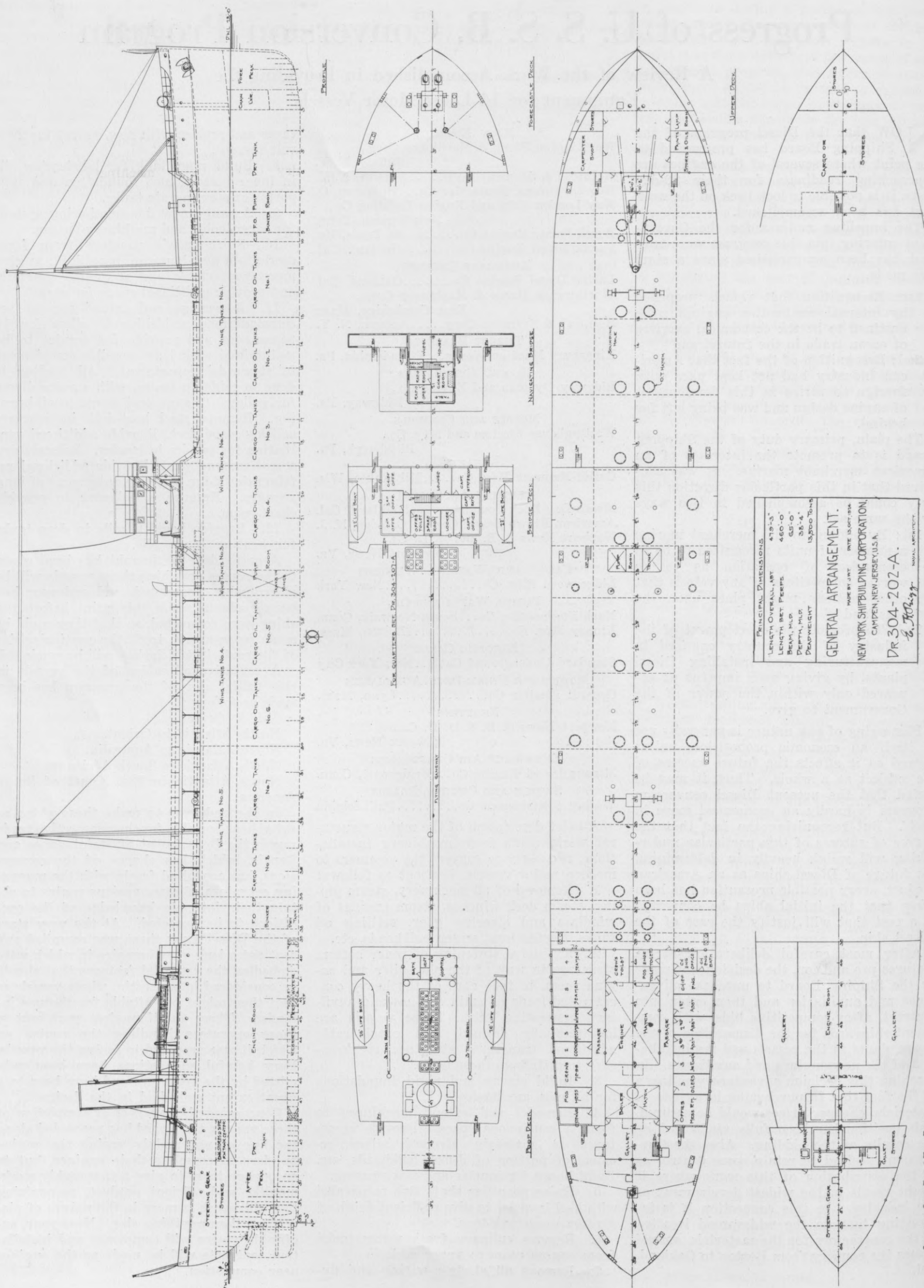
A great deal of thought has been given to the routes on which these vessels will be placed when completed, and endeavor has been made to settle this point before the ships were completed, so that they could be made more nearly to fit the particularities of the route in which they will be employed.

A tentative allocation of the vessels in this initial step of the program has been made as follows:

- Gulf to Orient.
- North Atlantic to Orient.
- North Atlantic to Australia.
- North Atlantic to South Africa.
- North Atlantic to East Coast of South America.

In the endeavor to make these ships as suitable as possible for the prospective trade routes the Department of Maintenance and Repair, which has charge of the conversions, has consulted freely with the managing operators of these various routes to obtain their intimate knowledge of the conditions to be expected. At the very start of the Diesel work there was compiled and sent out a long questionnaire in which were embodied the essential features that should be considered in converting these vessels so that they might be suitable for the use intended. These questionnaires were sent to those operators handling the routes on which it was proposed to assign the vessels. Very helpful suggestions have been submitted by the operators and have been to a great extent embodied in the design.

Concerning the prospect of completion of these vessels, the Board has proceeded along the line of not unduly urging the engine builders to complete their engines, but to encourage them to give a thoroughly workmanlike and efficient product, recognizing that this work is more in the nature of pioneering than anything else. Next year, engine deliveries will commence and installation contracts will be made as the engines near completion.



Large Motor Tankship at Camden Yard

Will Have 13,000 Tons d.w.c. and Be Driven by 3,000 s.hp.
Twin Screw Diesel Machinery

NO cessation of shipbuilding operations at the plant of what was formerly the New York Shipbuilding Corporation is to result from the recent acquisition of this firm by the American Brown Boveri Electric Corporation. While the hull of the 13,000-ton d.w. tanker which was laid down several months ago is nearing completion, corresponding progress is being made with the machinery installation. What is practically a final selection has also been

Following are the main particulars of the vessel:

Length overall	479 ft. 0 in.
Length between perpendiculars	460 ft. 0 in.
Beam, molded	65 ft. 0 in.
Depth, molded, to upper deck....	38 ft. 4 in.
Depth, molded, to tank deck....	24 ft. 8 in.
Designed loaded draft.....	27 ft. 6 in.
Total deadweight, 27-ft., 6-in. draft,	13,000 tons
Capacity main cargo tanks. 3,500,000 gallons	

cargo tanks, 10 wing tanks, 4 fuel tanks, fore hold pump-room, machinery space, a dry tank between machinery space and stern, and the usual peak trimming tanks.

One of the more noteworthy features of this tanker is the provision of an unusually large expansion trunk for the cargo space, by the help of which, it is reported, the ship will always be enabled to carry a full weight of cargo, irrespective of specific gravity variations due to varying temperatures or kinds of oil. Even with the lightest oil carried, the expansion trunk will possess the usual amount of air space when the vessel is down in the water to the load line, and when denser cargoes are shipped the expansion lee-way is somewhat increased. The expansion trunk is continuous and has a cubic capacity equal approximately to 30 per cent of the lower oil tank cubical contents.

Situated directly under the machinery space is a double bottom tank allotted to the feed water supply; as will be described shortly, the deck and cargo auxiliaries of this tanker are driven by steam generated in two Scotch boilers. Between the fuel oil tanks at the forward end of the machinery space and the main cargo tanks the usual cofferdam is fitted.

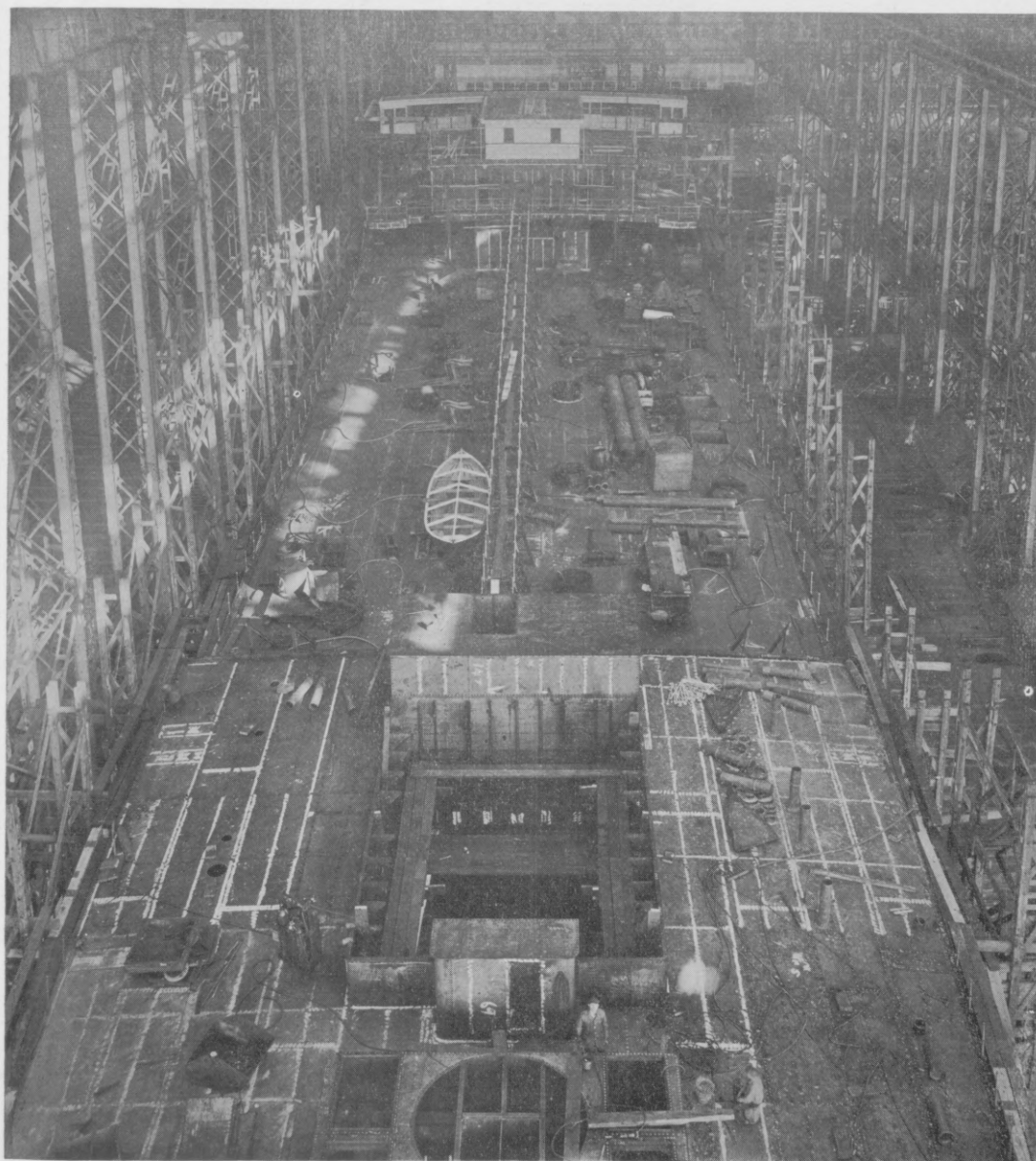
A steel bridge deck house, with wooden pilot house and chart-room above, are located on the poop deck between frames 19 to 22, while the usual flying gangway connects these spaces with the machinery space and accommodations aft. The crew is to be made up as follows:

Chief and 3 assistant engineers.	Seamen, 12.
Junior engineers, 3.	Steward.
Oilers, 3.	Cooks, 2.
Wipers, 2.	Messmen, 3.

Captain and 3 deck officers.

The accommodations also include a hospital and one spare room.

In the arrangement of the auxiliary, cargo-handling, and propelling machinery of this vessel, its designers have apparently been guided by the characteristic requirements of tankship operation and by the traditions established in the earlier motorship building carried out at the Camden, N. J., works of the New York Shipbuilding Company. Steam for heating cargo preparatory to pumping is more or less of a necessity on tank vessels, with the exception of those designed exclusively to handle the lighter and more fluid varieties of petroleum. With steam thus made available on the ship anyway, there seems to be every practical justification also for using this form of power to operate the relatively small amount of deck machinery required on the deck of a tanker. With the quick turn-arounds characteristic of this service, and the correspondingly slight use therefore made of auxiliary machinery, the extra steam consumption of this form of drive would not weigh heavily against the other advantages realized. For one thing, the steam may be used to operate emergency



Motor tankship on one of the covered ways at the Camden yard

made of the mechanical equipment to be placed aboard the ship.

Twin New York Werkspoor Diesel engines with an aggregate shaft power of 3,000 hp. are the heart of the propelling machinery, and two Ingersoll-Rand oil-engined generating sets of 72-kw. capacity each take the entire auxiliary load as long as the ship is at sea. A pair of Scotch boilers is fitted to take the greater share of the port auxiliary load, consisting mainly of deck-machinery operation and cargo heating and handling.

Capacity wing cargo tanks.	800,000 gallons
Total cargo capacity.....	4,300,000 gallons
Capacity fuel oil bunkers..	240,000 gallons

Built to the Isherwood system with its characteristic longitudinal frames, the ship possesses two complete decks extending over its full length from stem to stern. Situated directly above the machinery space, but not extending all the way to the stern, is a structure which encloses the engine-room casing and the engineers' accommodations. Oil-tight transverse and center-line bulkheads divide the ship into 16 main

engine-room auxiliaries such as a compressor for starting air and injection air and for running a small electric light generator.

The two Scotch boilers built by the American Brown Boveri Corporation have an internal diameter of 12 ft. 6 in. and afford a total heating surface of 1744 sq. ft. each in a length of 11 ft. 0 in., while their rated working pressure is 150 lb. They are oil-fired by means of four Mayflower 13-inch combined blowers and burners and deliver steam to some of the engine-room auxiliaries and to all of the deck machinery.

Without any help from any outside power sources the ship may quickly be put in operating commission about as follows:

Fresh water may be pumped by hand into the Scotch boilers, after which they may be fired with wood logs up to the point where they will give the slight amount of steam necessary for operating the vertical Warren fuel oil service pumps and the Bethlehem oil-burning equipment. With a full head of steam thus made available all the essential auxiliaries, such as bilge pump, lighting generator, warping and anchor winches may be operated, while either the auxiliary or the emergency air compressing sets may be put to work charging tanks with the air needed for starting the propelling and auxiliary Diesel engines. Should it ever become necessary to lay the ship up for a time and then to get it into commission again at short notice, the possibility of dispensing with outside assistance by following the general procedure thus outlined may be considered to offer substantial advantages.

In the case of an emergency, current for lighting and signalling could be obtained from the steam-driven generating set, which also has sufficient capacity to maintain steerage-way by means of the hydro-electric steering gear.

By far the largest single item of steam auxiliary machinery is the cargo pumping equipment consisting of four horizontal oil pumps with a 16-inch stroke and 14 and 18-inch diameter cylinders. The exhaust from these, as well as from all the other steam units, is returned to a 1900-sq. ft. condenser served by an auxiliary steam-driven centrifugal circulating pump.

Being fully aware that continuous operation of the steam auxiliaries at sea would add several tons to the daily fuel consumption of the ship, the designers of the new tanker have provided a complete line of oil-electric auxiliaries capable of maintaining all the essential services outside of propulsion. Two Ingersoll-Rand 3-cylinder engines, each direct connected to 72-kw. direct current generators, furnish current to the Hyde Windlass Co. hydro-electric steering gear as well as to the engine cooling water pumps, which are of the centrifugal volute type. A Worthington geared triplex plunger pump is available both for fire and bilge service. A smaller pump of this type is normally used for pumping bilges while the aforementioned unit is kept in reserve for emergencies. Other essential auxiliary services, such as pumping lubricating oil for the main engines and transferring fuel from the main tanks to the daily supply containers are similarly electric motor driven, and consist of Worthington positive-pressure rotary pumps. Similarly every engine-room auxiliary requirement, from lubricating oil purification up to

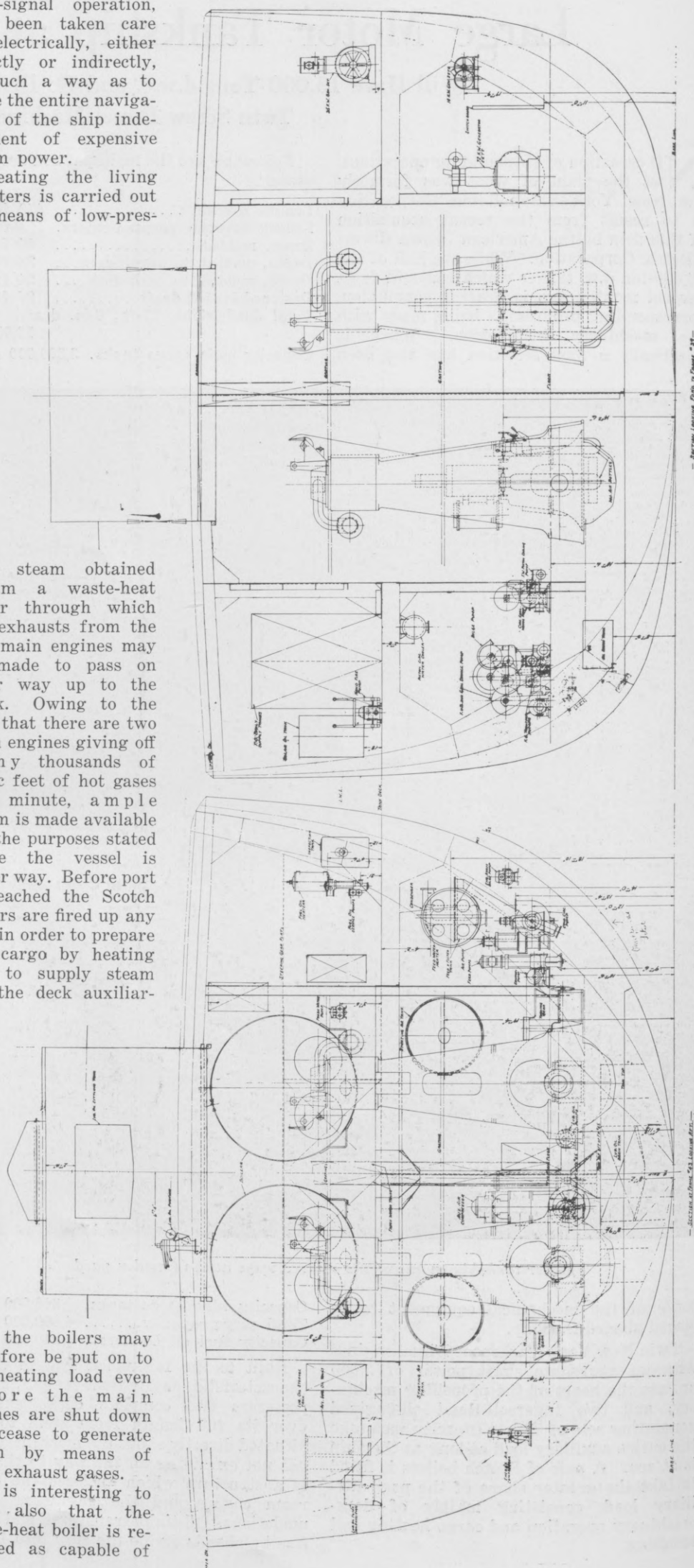
fog-signal operation, has been taken care of electrically, either directly or indirectly, in such a way as to make the entire navigation of the ship independent of expensive steam power.

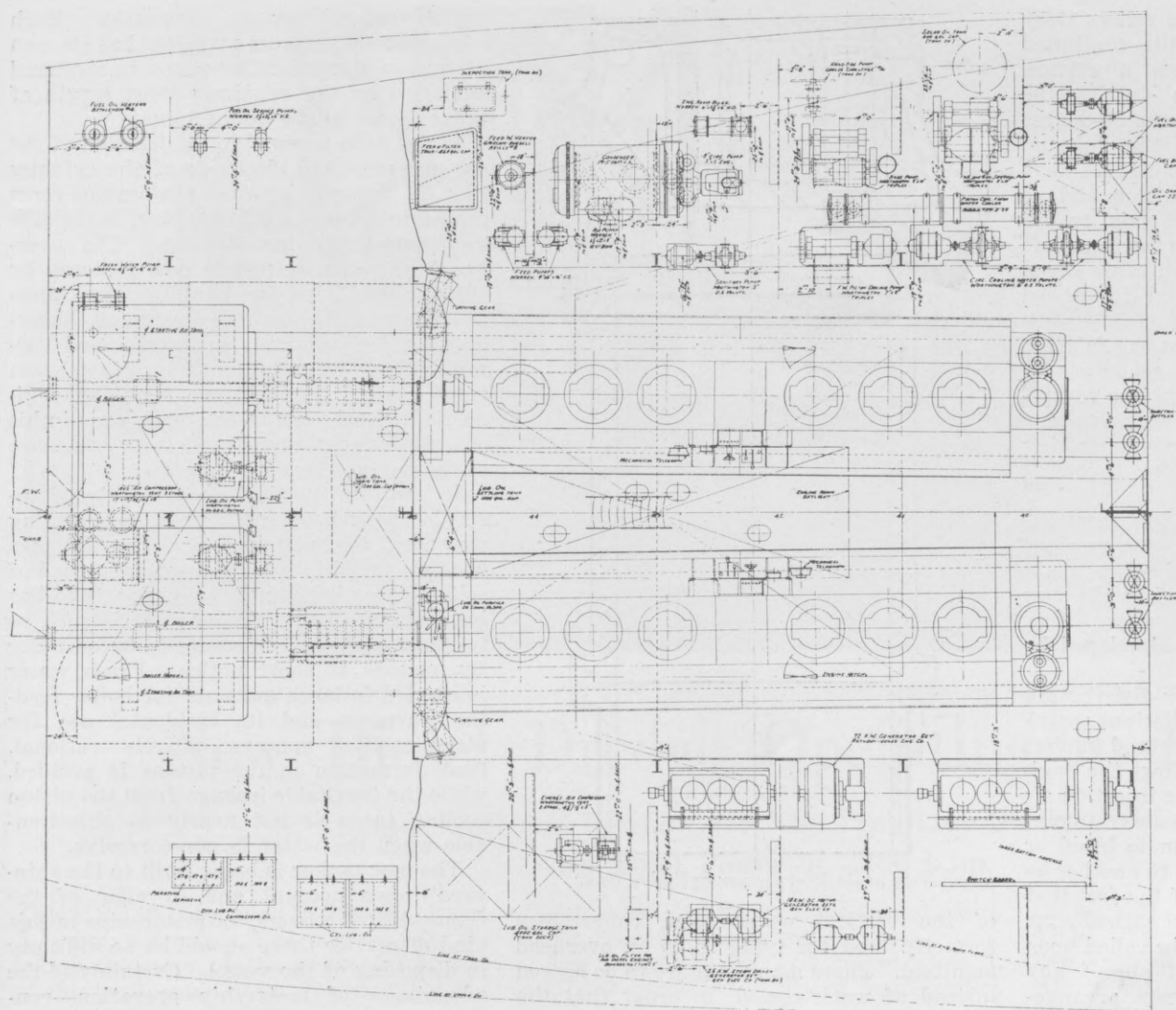
Heating the living quarters is carried out by means of low-pres-

sure steam obtained from a waste-heat boiler through which the exhausts from the two main engines may be made to pass on their way up to the stack. Owing to the fact that there are two main engines giving off many thousands of cubic feet of hot gases per minute, ample steam is made available for the purposes stated while the vessel is under way. Before port is reached the Scotch boilers are fired up any way in order to prepare the cargo by heating and to supply steam for the deck auxiliar-

ies; the boilers may therefore be put on to the heating load even before the main engines are shut down and cease to generate steam by means of their exhaust gases.

It is interesting to note also that the waste-heat boiler is regarded as capable of





the same design and patterns are being employed as those used in building the propelling unit of the motorships ASHBEE and JACKSONVILLE.

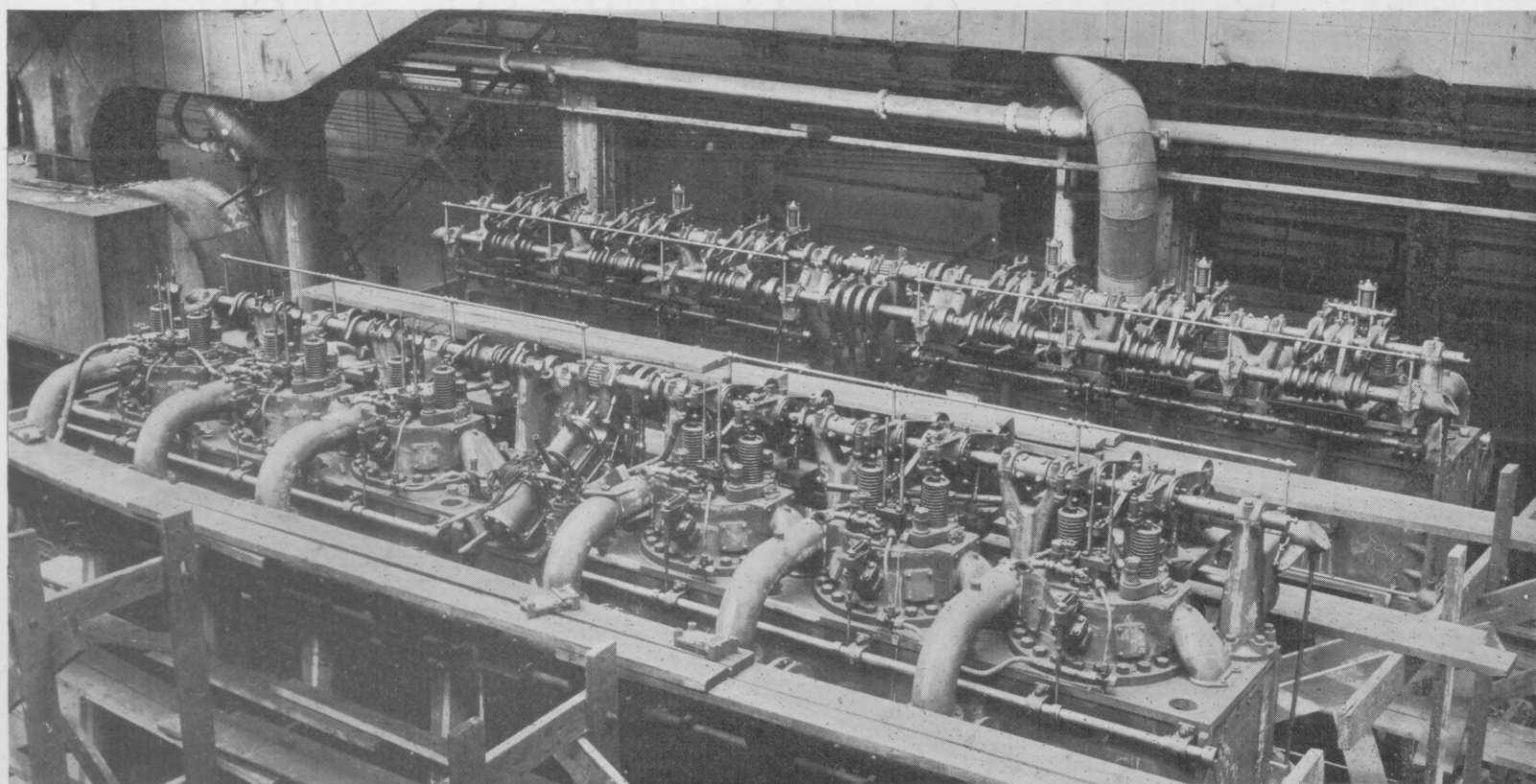
This is an engine built under Werkspoor license with slight modifications calculated to render its manufacture and operation more conformable to American practice. The steel tie-rods and cylinder beam characteristic of the original Werkspoor design are retained, enclosed in two-part cast-iron A-frames, the lower sections of which may be separately handled at assembly. The camshaft drive as well as the reversing system—characterized by the use of valve levers mounted on skew-eccentric fulcrums with ahead and astern cams keyed to a non-shifting camshaft—is substantially the same as that originally devised by Werkspoor in Amsterdam.

The fulcrum shaft about which the valve levers oscillate in response to the motion imparted to them by the

operating the steam smothering system for fire extinguishing. Should a fire occur at sea, it would be possible to divert all the gas-generated steam temporarily into the smothering lines. In the meantime it would be possible to fire up the Scotch boilers and to cut them in as soon as steam

had been raised in them. For smothering purposes, it will be recalled, only steam at relatively low pressure is required, such as would be immediately available from the exhaust gas boilers and as could be had after a short interval from the main boilers. In the construction of the main engines

cams, is fitted with discs, one for each lever, which are not only eccentrically mounted but which lie in planes not at right angles to the fulcrum shaft centerline. Reversing the engine consists merely in turning the fulcrum shaft through half a turn. As the result of this, the eccentricity of the ful-



Two sets of 1500 s.h.p. A. B. B.-Werkspoor engines built at the Camden plant for installation in the big tankship

crum discs first lifts the cam rollers clear of the extreme cam tops while continued rotation of the shaft causes a certain amount of sidewise motion due to the obliquity of the discs. After the 90-degree position in the rotation of the fulcrum shaft is reached, the eccentric centers have passed their extreme top position and as they descend they move the cam rollers down again, replacing them on the camshaft and in contact with the astern cams keyed directly next to the ones used for ahead running.

A rack geared to a pinion on the fulcrum shaft and deriving motion from an air-oil servomotor cylinder carries out the reversing operation in one stroke without any more attention on the part of the operating engineer than is necessary for throwing over a single hand lever.

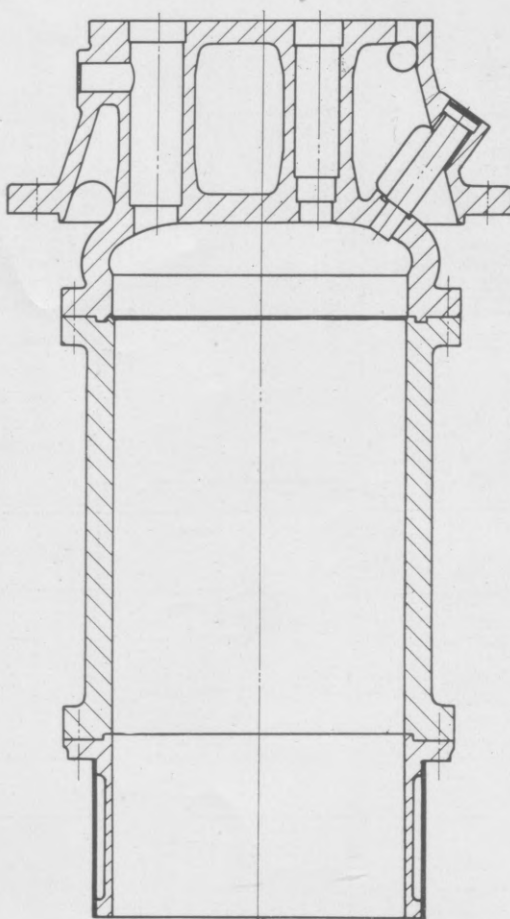
As has already been stated, the same designs and patterns used for the engines previously built at this yard were again employed for the engines fitted in the new tanker. The cylinder dimensions are 27 in. by 47 in., and 1500 s.h.p. are developed by each machine at 110 r.p.m.

New features include an air-distributing block (for twin-screw installations only) located at the maneuvering stand underneath the gauge-board. It allows the engineer on watch to control all the injection air lines for both engines from a central point and makes it possible for him to bleed or by-pass the air from one tank to another as conditions require. In view of the fact that only one licensed engineer is normally on watch at sea and that he may be called upon to maneuver both engines at almost any time, the advantages of the new arrangement are obvious.

In the engine itself separate cylinder liners, flanged within the water-jacket space to the downward-projections of the cylinder heads, are used. By this arrangement the advantages of the older integral construction are retained, i. e., the use of a heavy flanged joint in the way of the combustion space is avoided. As will be apparent from a little reflection, the joint between the upper end of the separate liner and the cylinder head is not subjected to the axial cylinder load as is the case with the joint between the cylinder head and the cylinder beam. The liner joint is therefore made up with relatively small bolts required simply for making up a gas-tight joint; in addition to that it is located far enough down to avoid metal accumulations in the neighborhood of the combustion space. At the same time the joint is situated high enough to make it unnecessary for any piston rings to travel over this joint.

Among the major advantages claimed for the separate-liner arrangement are that it allows a worn cylinder to be renewed at relatively slight expense and renders possible the use of a liner poured from metal better suited for it than would have to be employed for the entire integral casting. The construction really is equivalent to the use of independent and separate cylinder heads, on which there is nothing to wear out. Moreover, the foundry work involved in the production of the cylinder head is simplified and results in a lowered percentage of rejected castings.

Possibly the most striking of the new features consists in the use of horizontal exhaust elbows leading to a manifold running alongside of the cylinder beam in place



New style Werkspoor cylinder liner

of the vertical water-cooled connections formerly used for tying in to an overhead manifold. These manifolds are to be lagged instead of water-cooled, in order that the heat of the gases may be economized as far as possible for the sake of exhaust-gas boiler efficiency. At the same time clearing away the heavy pipes and connections from over the top of the engine has manifest advantages in so far as manipulation of the

engine valve gear is concerned. Each section of the exhaust manifold has its own expansion diaphragm, as would be rendered advisable by the relatively short length of the exhaust elbow connections.

In the twin-screw ship the location of the exhaust manifold alongside of the cylinder tops is favored because the engine-room casing interferes much less than is the case in single-screw installations. The overhead exhaust manifold is now replaced by suitable facilities for handling the valve-gear, as would be rendered especially desirable by the relatively large size and correspondingly heavy weights, such as exhaust valve cages. At the same time the engineer's general view of the machinery in his charge is unobstructed and the appearance of the engine-room improved.

In conformity with the recent trend towards the use of fresh water for cooling purposes, the piston cooling system has been arranged to use fresh water instead of salt. The piping necessary for this has been arranged, but its disposal is such as to enable salt-water cooling to be used for the pistons at short notice. Fresh water is carried in large amounts for boiler feeding purposes and its incidental use for piston-cooling appears entirely rational. Scale-formation in the pistons is avoided, while the inevitable leakage from the piston cooling tubes is not nearly so objectionable when the water is non-corrosive.

The new tanker is being built to the shipyard's own account and in view of the demonstrated economy of motorships in this kind of service there should be no difficulty in disposing of the vessel. Certainly if the advantages of motorship operation—rendered all the more pronounced by the conditions of tanker service—carry any weight with prospective purchasers, the chances are that cargoes will be waiting for her even before her trial trip has been completed.

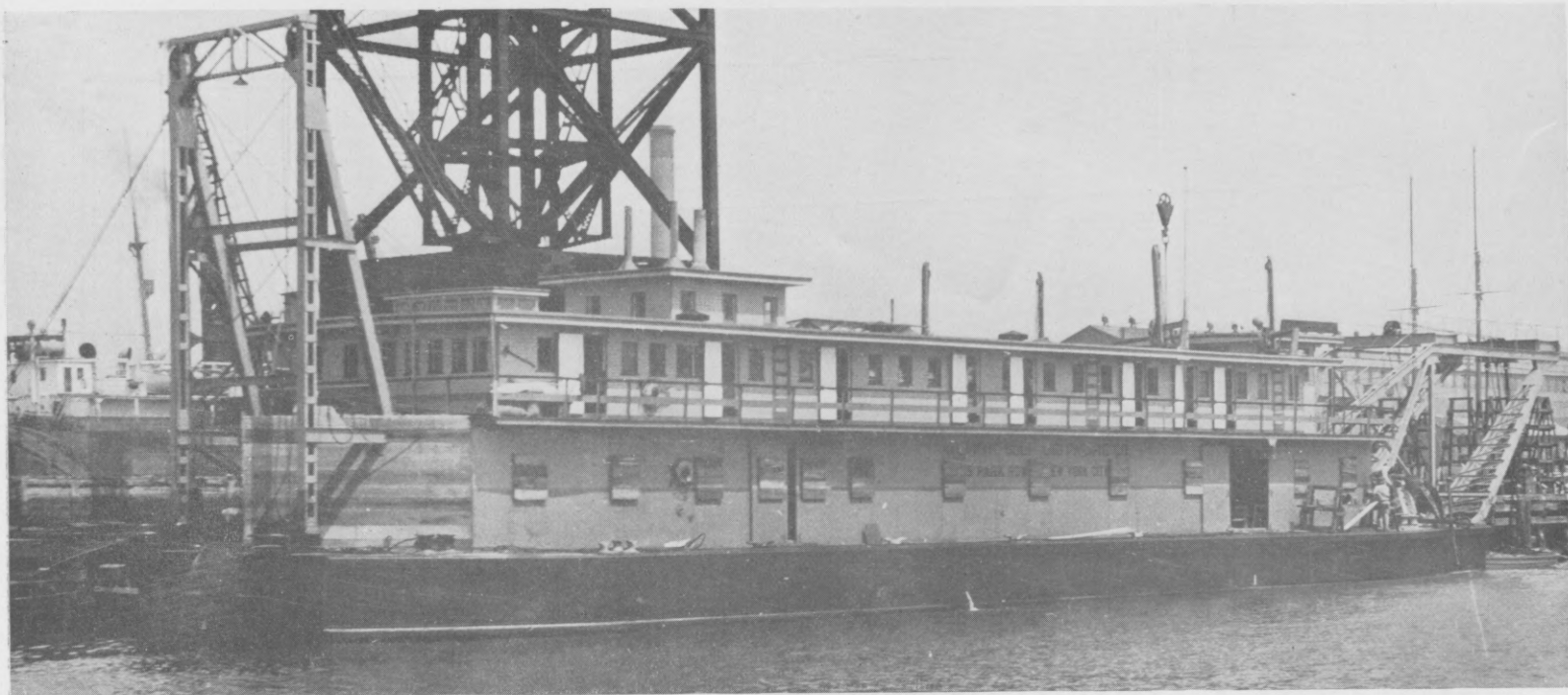
Ownership of Big Shipyard Changed

New York Shipbuilding Corp. is Sold to American Brown Boveri Electric Corporation of New York

LAST month the assets of the New York Shipbuilding Corp. were sold to a recently organized New York corporation, which is associated with the Brown Boveri Co. of Switzerland, one of the world's leading electrical manufacturers. The new company has an authorized capitalization of \$10,000,000 of 7 per cent cumulative preferred stock, 1,000,000 shares of no-par value participating stock, 300,000 shares of no-par value founders' stock and \$25,000,000 of 30-year first mortgage 5 per cent sinking fund gold bonds. The outstanding stock consists of \$3,000,000 cumulative preferred, 285,000 shares of participating stock and the full amount of founders' stock, in addition to \$5,359,600 of bonds. The participating stock was recently offered at \$50 per share. The plants at Camden, N. J., are among the largest in the country. The north and south yards have a total of 23 shipbuilding ways, four outfitting slips, seven piers and adequate shop capacity.

Brown Boveri & Co., Ltd., the Swiss company, will supervise the management of the

New York corporation and will be a large holder of founders' stock. This block of stock will be held in a voting trust. J. Elink Schuurman, one of the executive directors of the Swiss company, will be chairman of the board of the American corporation and will make his headquarters in America. Marvin A. Neeland, who has been president of the New York Shipbuilding Corporation for several years and prior thereto was with the U. S. Steel Corporation, will be chairman of the executive committee. The new president of the American Brown Boveri Electric Corp. will be Lawrence R. Wilder, who has for several years represented the Brown Boveri interests in the United States. Other American properties taken over by the new corporation consist of the Condit Electrical Manufacturing Co. of Boston, which has been engaged for over 20 years in the manufacture of switches, switching gears and other electrical apparatus, and the Scintilla Magneto Co., which has a plant at Sidney, N. Y., engaged in the manufacture of magnetos and other light electrical equipment.



Norfolk, a Diesel dredge with engines of 2200 b.hp. aggregate, at the fitting-out berth at the Newport News yard

New Diesel Dredge Operating in Florida

Atlantic, Gulf and Pacific Co.'s New Pipe Line Dredge Norfolk,
with Total Power of 2200 b.hp.

BUSINESS is booming in Florida. Every day magazines and newspapers are telling the story of the wonderful growth of this peninsular State, relating that the spirit of Ponce de Leon, which has been dormant for several centuries, seems to have suddenly awakened and is beckoning to thousands of persons who are wending their way to this southern State in search of health and wealth.

Naturally, this great land boom is having a beneficial effect on other lines of business, dredging being in the foremost rank. It is no wonder, therefore, that The Atlantic, Gulf and Pacific Company, upon the completion of its new Diesel-driven dredge NORFOLK, took her immediately to Florida, where she is at present engaged in filling in land at Palm Beach for the Palm

Beach Ocean and Realty Company, of which Paris Singer is president.

The NORFOLK was completed Oct. 1, and was immediately placed in operation, which has been high satisfactory according to the report from the New York office of the company at 15 Park Row. The dredge was designed and planned in the New York office and is said to be the last word in efficiency. The building of the hull and the installation of the quarters and machinery were done at the yard of the Newport News Shipbuilding and Dry Dock Co., Newport News, Va.

The NORFOLK is a hydraulic dredge, the diameter of the discharge pipe being 27 in. The main engine, of 1200 b.hp. was built by McIntosh & Seymour and drives the pump through step-up gears. This

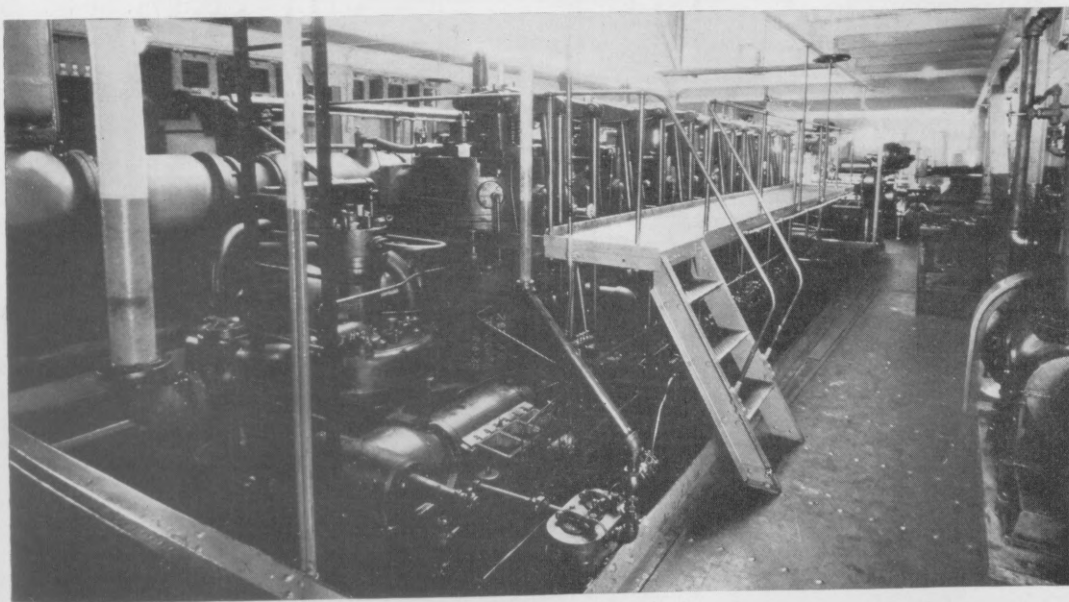
engine turns 150 r.p.m. and the pump 300 r.p.m. The dredge also is equipped with two 500 b.hp. McIntosh & Seymour engines. All of the auxiliaries are electrically operated by the power of these engines, driving two direct-connected generators. The electric equipment was manufactured by the Westinghouse Electric & Manufacturing Company. The dredge is equipped with a closed cooling system for the main engine, which will prevent mud and other sediment from accumulating in the water jackets when working in turbid water.

The hull, which is of steel construction, has a beam of 38 ft. and is 162 ft. long. The hold is 14 ft. deep. The dredge has quarters for 40 men, as well as offices for the executives and dining accommodations. Shower baths also are included in the equipment for the personnel. The heating system for the quarters is obtained from the exhaust gases from the engines.

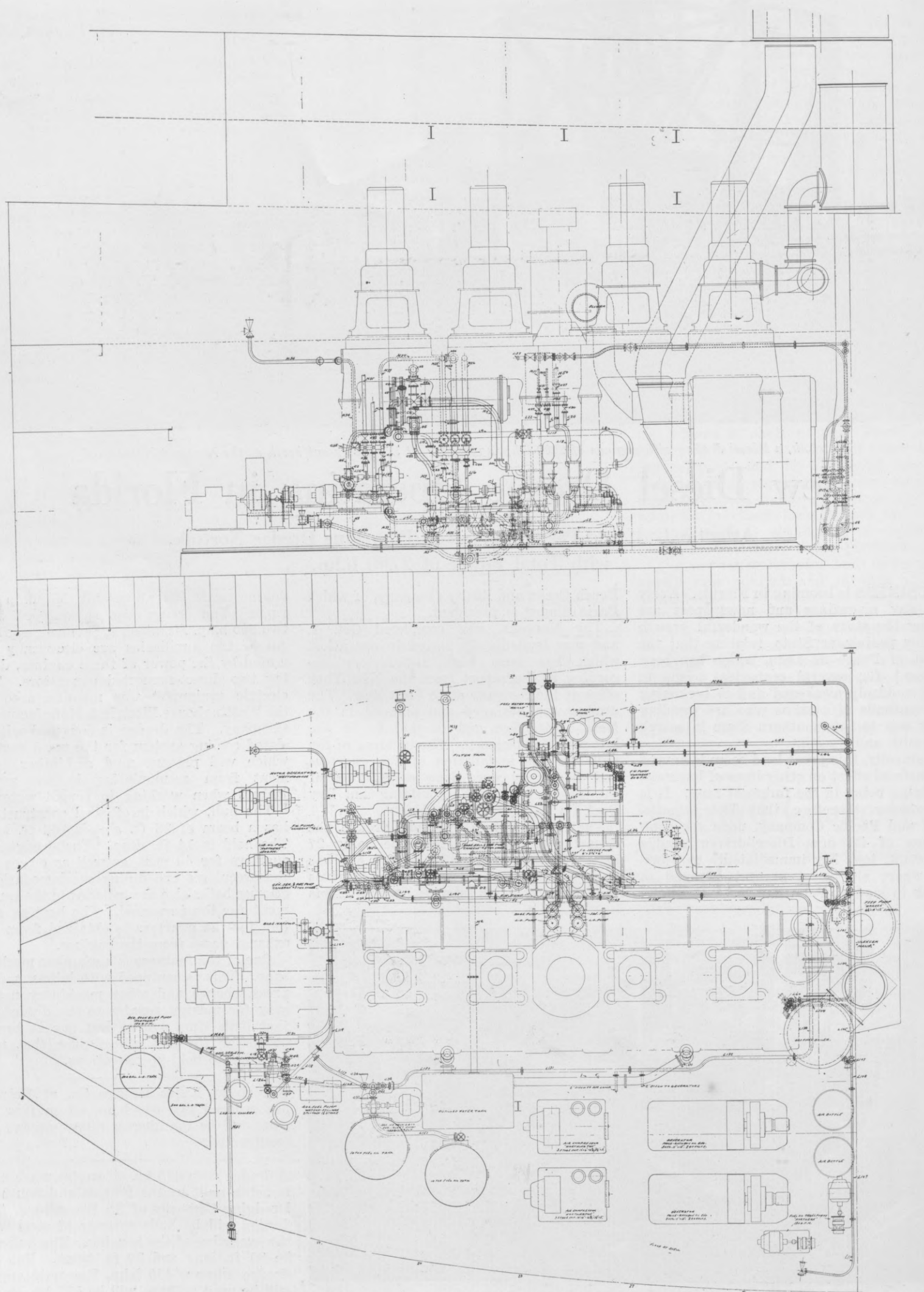
One of the features is a complete machine shop. This is equipped with lathes, a drill press, shaper and other machinery necessary for making repairs to the dredge, so that little time will be lost due to breakdowns or for any other cause that may be liable to hold up operations.

The Great Lakes Dredge Co. of Detroit, has ordered two 600 b.hp. oil engines for what will be the biggest dipper-dredge yet constructed.

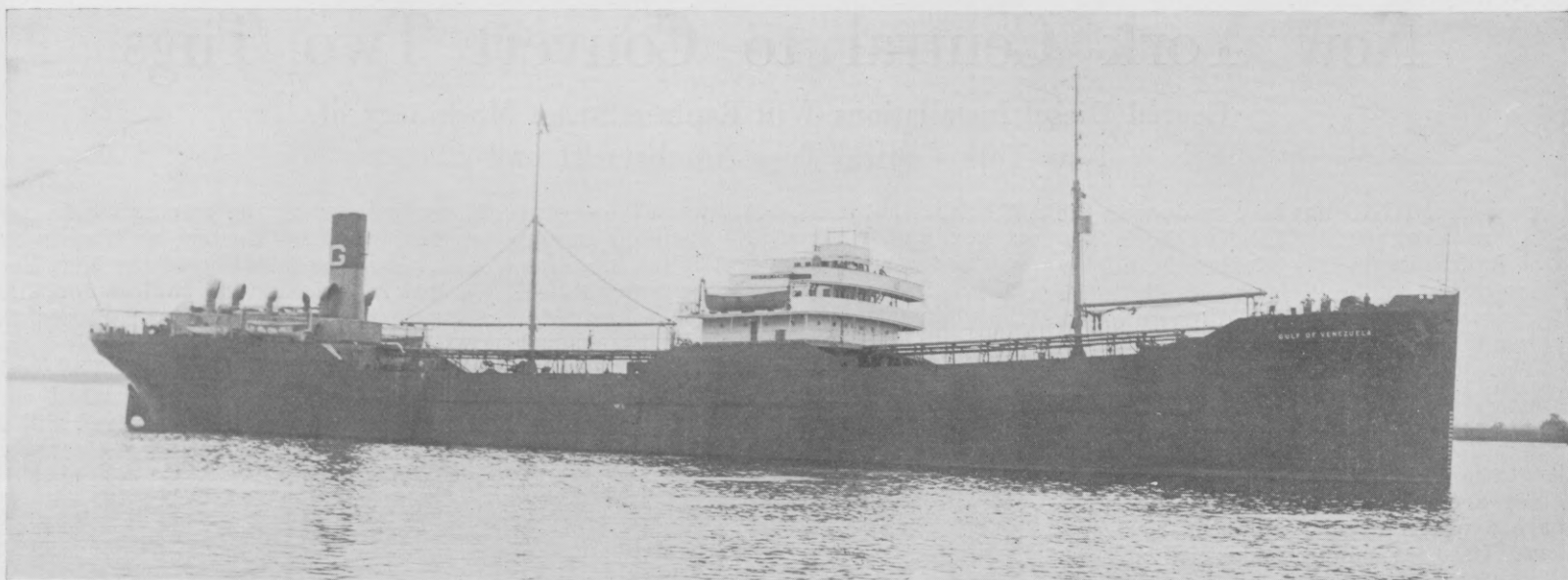
A dredge with 675 hp. oil engine machinery is being built by the Florida and Southern Dredging Company of St. Petersburg. The dredge will be built entirely of steel with the exception of the housing. The hull will be 80 ft. long and 30 ft. beam. For the dredge pump a 450 b.hp. Bessemer engine will be used. There will be 125 hp. on the cutter and 100 hp. on the winches.



Main engine of 1200 b.hp. geared up to the dredge pump of the Norfolk



Plan view and elevation of the main engine and auxiliary equipment in the engine-room of the converted tankship Gulf of Venezuela



This new unit of the Gulf Refining Company's fleet of tankships is notable for its economical layout of auxiliary equipment

Gulf Refining Company's Converted Tankship

Gulf of Venezuela, 9700 Tons, Now in Service with Diesel Machinery in Place of Steam

EARLY this year the Gulf Refining Company purchased from the Shipping Board a single-screw steam tanker of about 9700 tons dw. which it contracted with the Board to convert to the more economical type of oil engine propulsion.

A contract was made with the Sun Shipbuilding and Dry Dock Co. to supply the main engine and undertake the conversion. The vessel was sent to the

Chester yard about the middle of March, where it was placed in drydock for examination and later transferred to the wet basin for the dismantling of the steam machinery. Six months later the converted vessel was sent on trial, which she satisfactorily completed, and was then taken over by the owners who sent her to Port Arthur, Tex., on her maiden voyage.

This vessel has been renamed GULF OF

VENEZUELA. Under Shipping Board ownership she was known as the MISKIANZA. Her principal characteristics are as follows:

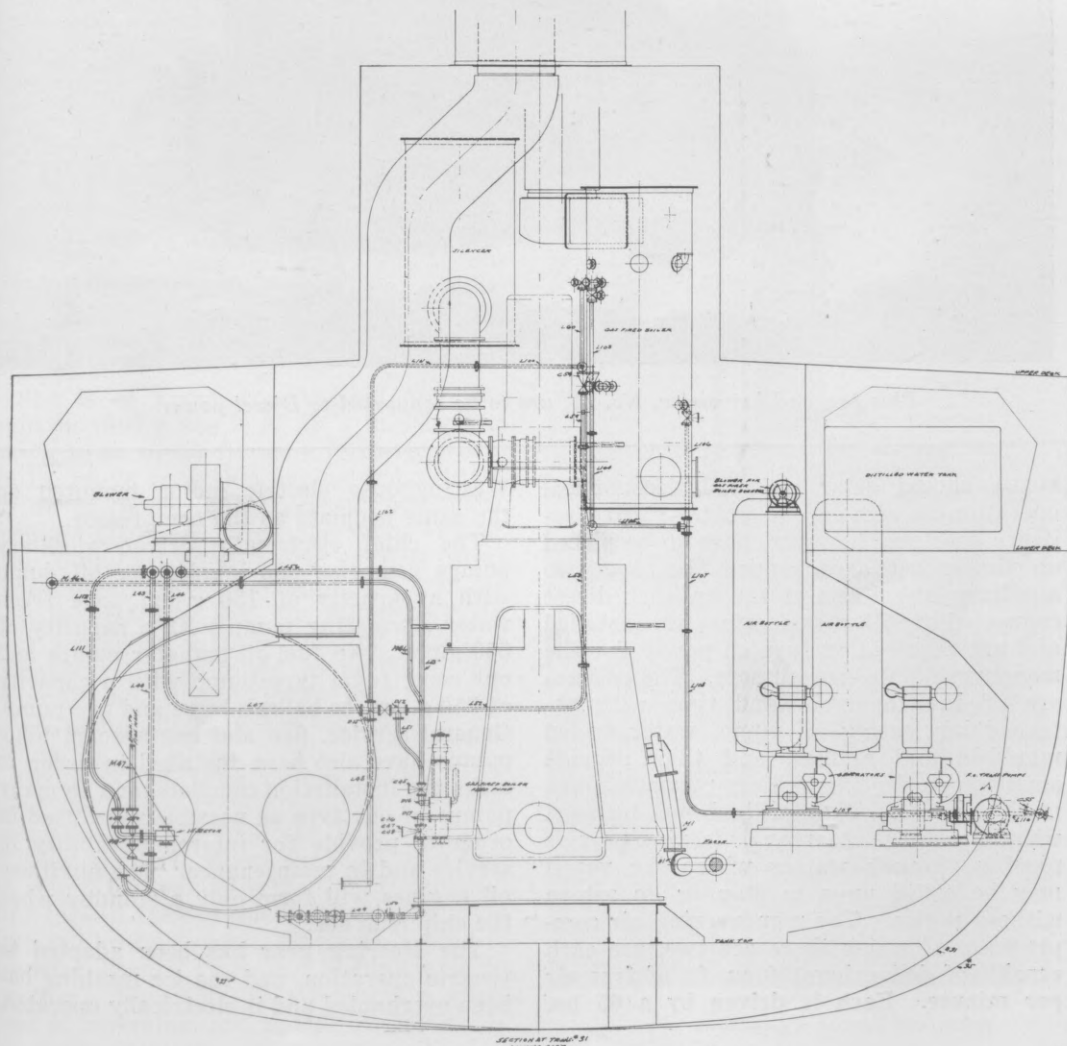
Length b.p.	425 ft. 0 in.
Beam	57 ft. 0 in.
Depth	33 ft. 0 in.
Loaded draft	25 ft. 7 3/4 in.
Deadweight	about 9700 tons
Gross Register	6661 tons
Power	2500 s.h.p.
Speed, loaded, on trial	11 1/4 knots

This vessel previously was equipped with three Scotch boilers and a geared turbine installation. Two of the main boilers and practically all of the steam auxiliaries in the engine room were removed, and a complete rearrangement of the machinery was developed in order to adapt the vessel to a direct Diesel drive by the installation of a 4-cylinder, 2-cycle Sun-Doxford opposed piston engine of 2500 s.h.p.

The main engine is fitted with the usual scavenging pump which is standard on this type of engine, but a departure from previous Sun practice is the connection of lubricating oil pumps, fresh and salt water circulating pumps and bilge and sanitary pumps to the main engine. This makes a complete unit permitting the vessel to be operated at sea without using extra fuel for motor driven auxiliaries.

One Scotch boiler has been fitted for burning oil, but will be used only when the vessel is in port and then only if cargo is to be discharged. The original steam driven cargo pumps have been retained. When they are being operated in port the Scotch boiler will be under steam and can take care of the heating of the vessel if necessary and supply one or other of the two steam-driven auxiliary electric generators of 15 kw. each. These two steam generating sets are really the key in this vessel to economical operation of auxiliaries both at sea and in port. They furnish electric power for lighting and for the auxiliary pumps that have to be used in port. When the Scotch boiler is fired none of the oil engines need be kept in operation.

(Continued on page 826)



New York Central to Convert Two Tugs

Geared Diesel Installations Will Replace Steam Machinery of
New York Central Tugs Numbers 21 and 22

A BEGINNING has been made with the modernization of the New York Central Railroad's floating equipment in New York harbor by the decision recently taken to convert tugs Nos. 21 and 22 from steam power to oil engines.

These boats were built in 1899 by Marvel with Delaney leg boilers and tandem compound engines with 15 in. x 30 in. cylinders and a 22 in. stroke. They are 90 ft. in length over all and 20 ft. beam. The engines are non-condensing, and the boats have a water capacity of about 8000 gallons. Used for many years as coal burners, they were converted in 1924 to fuel oil burners.

At the end of this year they would have had to be reboilered, which would have been a considerable expense, and when the officials of the marine department compared the cost of operation of these boats with their estimated cost of operation as motor tugs, it was found that the conversion to oil engine power could be made at a net cost which would be covered by the operating savings in three or four years.

Owing to the low freeboard of these two tugs the decision was made to restrict the Diesel machinery and thus permit a greater freeboard to be obtained. This confined the choice of engines because the limiting weight was 20 long tons.

For one boat an Ingersoll-Rand engine has been ordered, and for the second boat a Winton engine, both sets being of 250 hp. The Ingersoll-Rand engine will turn at 350 r.p.m. and the Winton engine at 375 r.p.m. Both will be connected to the propellers through a combination of gears and clutches. The arrangement has been designed by the marine department of the New York Central R. R. for gears to be furnished by the Falk Corp., with clutches of the Metten type to be manufactured by Cramp's.

The arrangement of gears adopted in this case places the engine shaft and propeller shaft on a common axis, giving a reduction in weight as compared with other arrangements and eliminating the sub-

structure that is necessary when the engine is on a higher plane. No auxiliary engine will be installed, because it is the intention to run all the pumps, steering gear, etc., off the main engine. Apparatus is being designed to put the power under the control of the captain in the pilot house as if Diesel electric propulsion were used.

All the construction work in connection with the conversion of these two tugs will

be carried out by the marine repair shop of the New York Central at Weehawken, N. J. It is the intention of the New York Central in ordering the engines for these boats to make a comparison between the respective operating merits of air spray injection and airless injection. The working of the engines will be watched very closely, and the experience derived will be used in future orders for oil engines.



This tug and her sister, No. 21, are to be converted to Diesel power

Gulf Refining Company's Converted Tankship

(Continued from page 825)

At sea the main engine directly operates one set of the auxiliary pumps that have to be kept in service throughout the 24 hours, and under normal circumstances the electric current for lighting and for such other power as may be required—for instance, for the fuel oil transfer pumps—will be provided by steam furnished from a waste heat boiler heated by the exhaust gas from the main engine. The capacity of the waste heat boiler is sufficient to take care of the steam driven generating sets and alternatively for driving the cargo pumps at half speed that may be used in cleaning tanks and for other similar purposes. Under these conditions the GULF OF VENE-

ZUELA should show unusually economical operation at sea and in port. Entire reliance does not, however, have to be placed on this novel arrangement, because two auxiliary Diesel sets of 110 hp. each direct connected to 65 kw. generators are installed and are required to furnish power for the maneuvering air compressors. The engines are of the Ingersoll-Rand type with attached lubricating oil pump, water cooled manifold and muffler, and they provide ample power for all auxiliary purposes when need requires. They will always be used when a vessel is entering or leaving port or passing through waters where the vessel may be called upon to stop or go astern without notice. The maneuvering air compressors, of which there are two, are each capable of delivering 150 cu. ft. of free air per minute. Each is driven by a 65 hp.

Westinghouse electric motor mounted on the same bedplate as the compressor.

The chief electrically driven auxiliary pumps comprise one lubricating oil pump with a capacity of 150 g.p.m., one fresh water circulating pump with a capacity of 550 g.p.m., two fuel oil transfer pumps and one centrifugal type pump with a capacity of 550 g.p.m. as ballast, bilge and fire pump. General service, fire and engineroom bilge pumps have also been installed in order to make the installation complete, and as many pumps of one type as possible were used in order to provide for interchangeability in service and in maintenance. The auxiliary oil engines will form only a standby when the ship is at sea.

The steering gear has been adapted to electric operation, and the ice machine has been overhauled and is electrically operated.



Sand and gravel loading racks at Port Washington, L. I., where the Zack and Goodwin 14 take their tows

Converted Tug Cuts Fuel Bill 80 Per Cent

Goodwin, Gallagher Sand & Gravel Co.'s Motor Tug Goodwin 14
Saves \$2500 a Month on Fuel

SO SUCCESSFUL has been the operation of the Diesel-equipped tugs ZACK and GOODWIN 14, that the Goodwin, Gallagher Sand & Gravel Company of New York, the owners, probably will install similar equipment in some of their other tugs when it becomes necessary to scrap the present engines and boilers.

Almost two years have passed since the company became interested in Diesel-equipped tugs. About 18 months ago, it had the tug ZACK built by the Port Washington Shipyard and Motor Company, Port Washington, L. I. This boat, only 40 ft. long, was equipped with a 100 hp. Fairbanks-Morse engine. She was put in service shifting boats in and out of the pockets and assisting in making up the tow at the stake boat.

Since being placed in operation the ZACK, it was stated, has exceeded the company's expectations. She has taken the place of a 150 hp. steam tug and a gasoline tug, and the saving in time, fuel and effort so impressed the officials that when it was necessary to change the engine and boiler in the GOODWIN 14, they decided to install Diesel equipment.

She is of frame construction and was built in 1909. She is 85 ft. 3 in. long and has a beam of 26 ft. She formerly had a 20 in. by 26 in. steam engine and a 10 ft. by 14 ft. boiler. Her present equipment includes a 300 hp. Fairbanks-Morse engine, two 15-hp. Fairbanks-Morse engines direct connected to 9 kw. generators, a 4½ in. by 4½ in. Gardner-Rix air compressor direct geared to a 10 hp. electric motor, a centrifugal pump direct connected to another 10 hp. electric motor and a rotary bilge pump direct connected to a 2 hp. motor.

GOODWIN 14 tows barges loaded with sand and gravel from Stake Boat No. 3 at Hempstead, L. I., to Stake Boat No. 2 at Whitestone, L. I., where she picks up a load of empty barges and returns to Hempstead Bay to wait for the tide before taking them into the loading racks. She also is used to transfer barges from one loading pier to another. Naturally, this requires a great deal of reversing, and in this connection, it

was stated at the office of the company that the ZACK, which is engaged almost entirely in work of this kind, is compelled to reverse almost constantly and little or no time is lost in the operation. This, it was pointed out, could not be done very well with a steam-operated tug without much loss of time.

GOODWIN 14 formerly used from 275 to 300 tons of coal a month, it was declared at the office, this necessitating a cost of from \$2,800 to \$3,000. Then in taking on fuel she frequently lost much time in being compelled to wait her turn at the coal docks. Moreover, whereas she had to go to New York every two days to take on coal, she now makes the trip but one in five weeks for oil.



The company's second motortug

Her oil bill, it was pointed out, amounts to between \$450 and \$500 a month. It was shown that on July 30 she took on 9290 gal. of oil, and did not come in again until September 22, when she received 10,000 gal. of oil.

Among recent orders secured by the Winton Engine Company are four marine units of 800 b.hp. each.

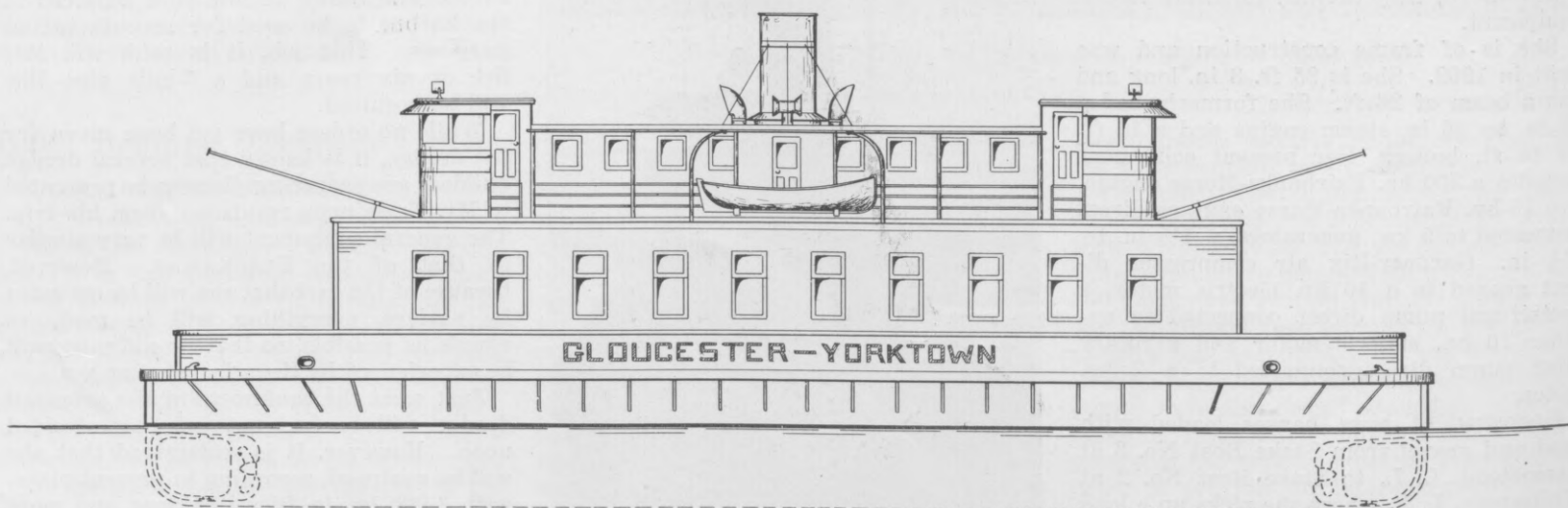
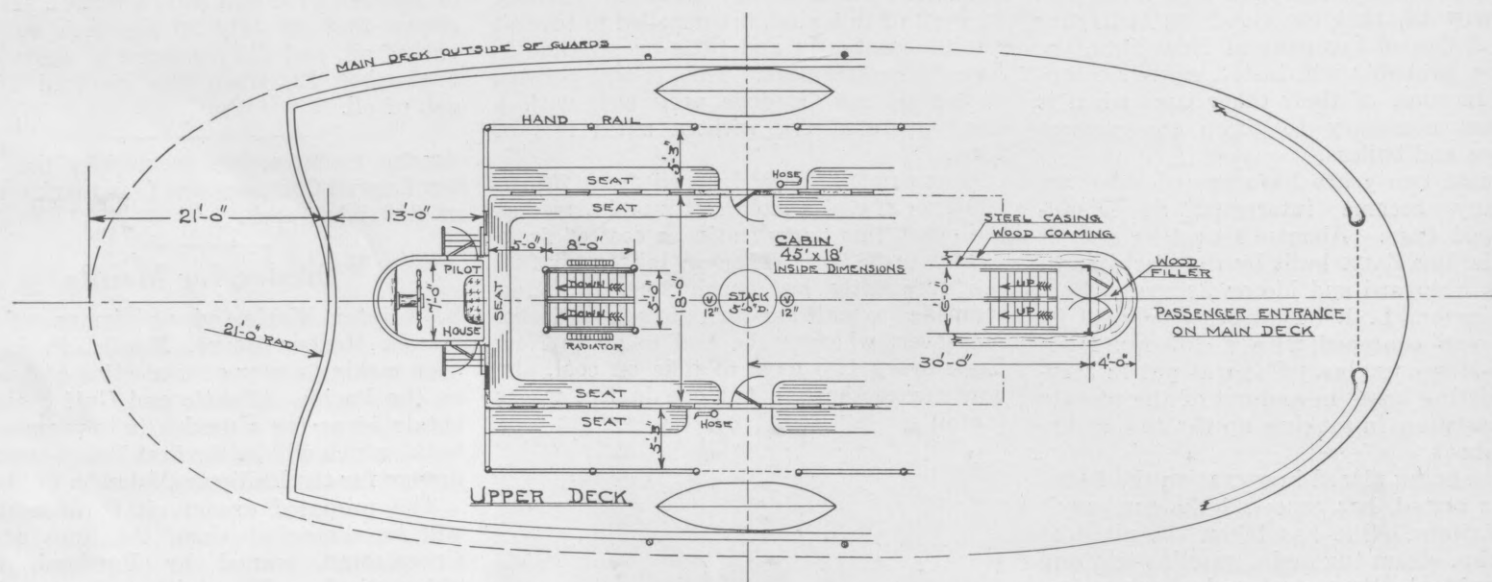
Dredge for Manila

E. Clinton Earle, vice-chairman of the Manila Harbor Board, Manila, P. I., has been making a tour of inspection of dredges on the Pacific, Atlantic and Gulf coasts to obtain ideas for a dredge it is proposed to build, which will be the first Diesel-operated dredge for the Philippine Islands.

The proposed dredge, it is understood, will be somewhat along the lines of the CLACKAMAS, owned by Portland, Ore., although she will not be as large. It is expected to place her in operation dredging an area back of the breakwater in Manila harbor and filling in low land adjacent to the harbor to be used for manufacturing purposes. This job, it is said, will last five or six years and a 5-mile pipe line will be required.

While no orders have yet been given for the dredge, it is known that several dredge builders are preparing plans to be presented to Mr. Earle upon returning from his trip. The general equipment will be very similar to that of the CLACKAMAS. However, because of the fact that she will be operated by natives, everything will be made as simple as possible, so that no difficulty will be experienced by them in running her.

Just what the equipment of the proposed dredge will be has not yet been decided upon. However, it is understood that she will be equipped, according to present plans, with 3,000 hp. in Diesel engines and more than 2,000 hp. in electric motors, all of which are smaller than on the CLACKAMAS. The pipe line, it is said, will have three 2,000 hp. booster motors for alternating current, which will get their power from a central station on land.



— STEEL MOTOR DRIVEN FERRY BOAT —
 — FOR —
 GLOUCESTER-YORKTOWN FERRY
 — OF —
 GLOUCESTER POINT, VA.

EADS JOHNSON M.E., INC.
 NAVAL ARCHITECTS & MARINE ENGINEERS
 113 BROADWAY
 NEW YORK

— 1925 —

Virginia Ferry With Double-end Drive

Diesel Engined Boat with Capacity for 35 Autos Shortens Route
for Southern Motorists

YORK, the automobile ferry recently placed in service between Gloucester Point, Va., and Yorktown, is an interesting example of how well adapted the Diesel engine is to the problem of a double-end drive. The 240 hp. Fairbanks-Morse engine is direct connected to the propellers, one being forward and the other aft. Both propellers are of the same size, and divide the power in proportion to their efficiencies when pulling and pushing.

This ferry is owned and operated by W. T. Ashe of Gloucester Point, Va., and replaces a smaller boat powered with a 60

ber 4. The ferry is designed to take between 30 and 35 motor vehicles placed in four lines on the main deck. The dimensions are as follow:

Length overall	115 ft. 0 in.
Breadth molded	35 ft. 0 in.
Breadth over guards	44 ft. 0 in.
Depth molded	12 ft. 0 in.
Draft	7 ft. 0 in.

The hull is constructed of steel, with a wood main deck supported by fore and aft steel trusses and two rows of stanchions. There is an upper deck and house to accom-

on the main engine is sufficient to maintain the pressure in two of the tanks. These two tanks are of sufficient capacity to hold enough air to do all the maneuvering ordinarily necessary for handling the boat. For fire purposes a 2 in. centrifugal pump is driven by a 5 hp., 1750 r.p.m., 115-volt compound wound ball bearing motor. The ordinary bilge service is taken care of by a 2½ in. x 3 in. plunger pump, driven from the main engine shaft. Should the boat develop a bad leak the fire pump is so connected that it can be used for bilge service.

On September 4, the machinery and auxiliaries were given a dock trial and the boat left the builder's yard on September 6 for Gloucester Point. Although no trial trip had been made, the run of 142 miles from Baltimore to Gloucester Point was very successful. On this run the fuel consumption was 8 gal. per hr., although, since the boat has been placed in service, this has dropped to 7½ gal. per hr. With the engine turning at 215 r.p.m., the boat made approximately 9.13 m.p.h. on this trip.

In regular service the boat makes two round trips every hour, the running time from dock to dock being about eight minutes. It has been found that the double-end drive enables the boat to dock quickly and to get away quickly on the return trip, as there is no time lost in turning around. In handling the boat the forward rudder is locked in a central position by a sliding bolt and the other rudder is used for steering.

Five motor yachts are under construction at the yard of the Newport News Shipbuilding and Dry Dock Company.

More Golden Gate Ferries

Prices on one to three Diesel-engined ferryboats have been sought by the Golden Gate Ferry Co. from the shipyards on San Francisco Bay. The specifications were issued last month and bids were to be submitted by October 30. It is estimated that the new vessels will cost some \$500,000 each, representing therefore a total of \$1,500,000 if three vessels are ordered.

These boats are expected to be larger than the Diesel driven vessels GOLDEN GATE and GOLDEN WEST which the company has been operating with satisfaction for a considerable period. The new boats will probably have Diesel electric propulsion with three 400 b.hp. engines to provide the power. They are to be used on a triangular service between Berkeley, San Francisco and Sausalito, which the company hopes to inaugurate soon. On this service three ferries will be kept running in each direction, so that the conveniences of a direct point-to-point service will be available, in addition to the advantage of a round trip for visitors to San Francisco Bay.

A report on the operation of the Golden Gate Ferry Company's present Diesel boats, the GOLDEN GATE and GOLDEN WEST was given in MOTORSHIP of April, 1925.



New Diesel engined automobile ferry York in service in Virginia

hp. Fairbanks-Morse engine. Increased business made it necessary to put on a larger boat, and Mr. Ashe, after investigating various types of engines and drives, decided on Diesel engines with the double-end arrangement. The ferry connects two of the main highways of Virginia, and tourists traveling between the northern and southern States find a great saving of time by crossing the river instead of taking the other routes.

Eads Johnson, naval architect of New York, designed the vessel, and she was built by the Spedden Shipbuilding Company of Baltimore, Md., in record time. The contract was signed March 28, 1925; the keel was laid May 18; the boat was launched August 19, and completed September

modate passengers. Between the main and upper deck a steel casing 60 ft. long and 6 ft. wide encloses the engine-room space and stairways.

In addition to the 240 hp. engine, Fairbanks, Morse & Co. also provided the auxiliary equipment. A 15 hp. 2-cylinder engine direct connected to a 9 kw. 125-volt direct current generator supplies current for lighting and for driving the electric auxiliaries. Starting air is supplied by a 4½ in. by 4½ in. single-cylinder water-cooled air compressor driven by a 7½ hp., 1750 r.p.m., 115-volt Fairbanks-Morse ball-bearing motor. This compressor pumps to four 30 in. by 96 in. air tanks. This gives the engineers two tanks for reserve purposes, as the capacity of the air compressor

J. Livermore's New American Motoryacht

Large Yacht Building at Lawley Yard Will Have 1,600 s.hp.

Main Propelling Engines of American Construction

ONE of the largest and most powerful Diesel engined yachts ordered in this country is now under construction at the yards of George Lawley & Son, to designs by Henry J. Gielow, Inc., for Jesse L. Livermore, prominent member of the New York Yacht Club.

This vessel will have twin screws driven by engines of 800 s.hp. each, the largest American built engines yet installed in any Diesel yacht. The leading dimensions of the boat will be—

Length overall 170 ft. 3 in.
Length on load water line..... 162 ft. 10 in.
Beam, molded 27 ft. 4 in.
Draught 13 ft. 0 in.

The plans show accommodations in the forward part for the crew. The forepeak on the main deck is occupied by the fore-castle with berth arrangement for 10 men, toilets, lavatories, shower, and individual steel wardrobes. On the lower deck six staterooms are provided, giving accommodations for 12 men. These quarters will be occupied by the chief engineer, mates, cooks, stewards and assistant engineer. The officers' bathroom is also provided in these quarters. Their mess room is located just forward of the galley. Each officer's room is provided with wash basin, locker, seats, desk, bureau, etc. The galley occupies the full width of the boat and is equipped with an oil-burning range, garbage shoot, Arco hot water heater, large refrigerator for day stores, and necessary dressers, lockers, sinks, etc.

The owner's quarters are located aft of the engine room and are separated from the engine by means of a double steel insulated

bulkhead. Aft of this bulkhead, and separating the engineroom from the owner's main stateroom, are two well equipped white porcelain tiled bathrooms on the port and starboard sides, equipped with the most modern up-to-date plumbing fixtures of the house flush type, with two big wardrobes located between the bathrooms. This entire space acts also as a sound deadener for any possible noises that might occur from the engines. The owner's stateroom occupies the full width of the boat and is about 11 ft. long fore and aft. It will have the usual equipment of bureaux, chiffoniers, dressing table, desk, night table, etc.

Guests' quarters are aft of the owner's stateroom and consist of three double staterooms with two beds and two single staterooms with single berths, all having access to bathrooms and all equipped with wardrobes, bureaux, dressing tables, chiffoniers, etc.

On the main deck there will be a continuous steel deck house, the forward part of which will be occupied by the dining room, which is 24 ft. long, with a mean width of 18 ft. 6 in. so that it will be possible to seat comfortably at the table 16 persons. A built-in sideboard and buffet are on the after bulkhead of the dining room. The pantry is located just aft of the dining room, with the steward's room opening on the port side just aft of the pantry, while on the starboard side will be a deck toilet and wash room. Lockers on the starboard side of the passageway are provided for oilskins, guns and fishing rods. On the port side are the entrance to the engine room, the large deck locker, and the big trunk room. At the after end of the

house is the living room 25 ft. long with a mean width of 20 ft. A large quarter-deck aft is provided, over 50 ft. in length, with a windbreak or deck shelter extending out from the sides of the deck house.

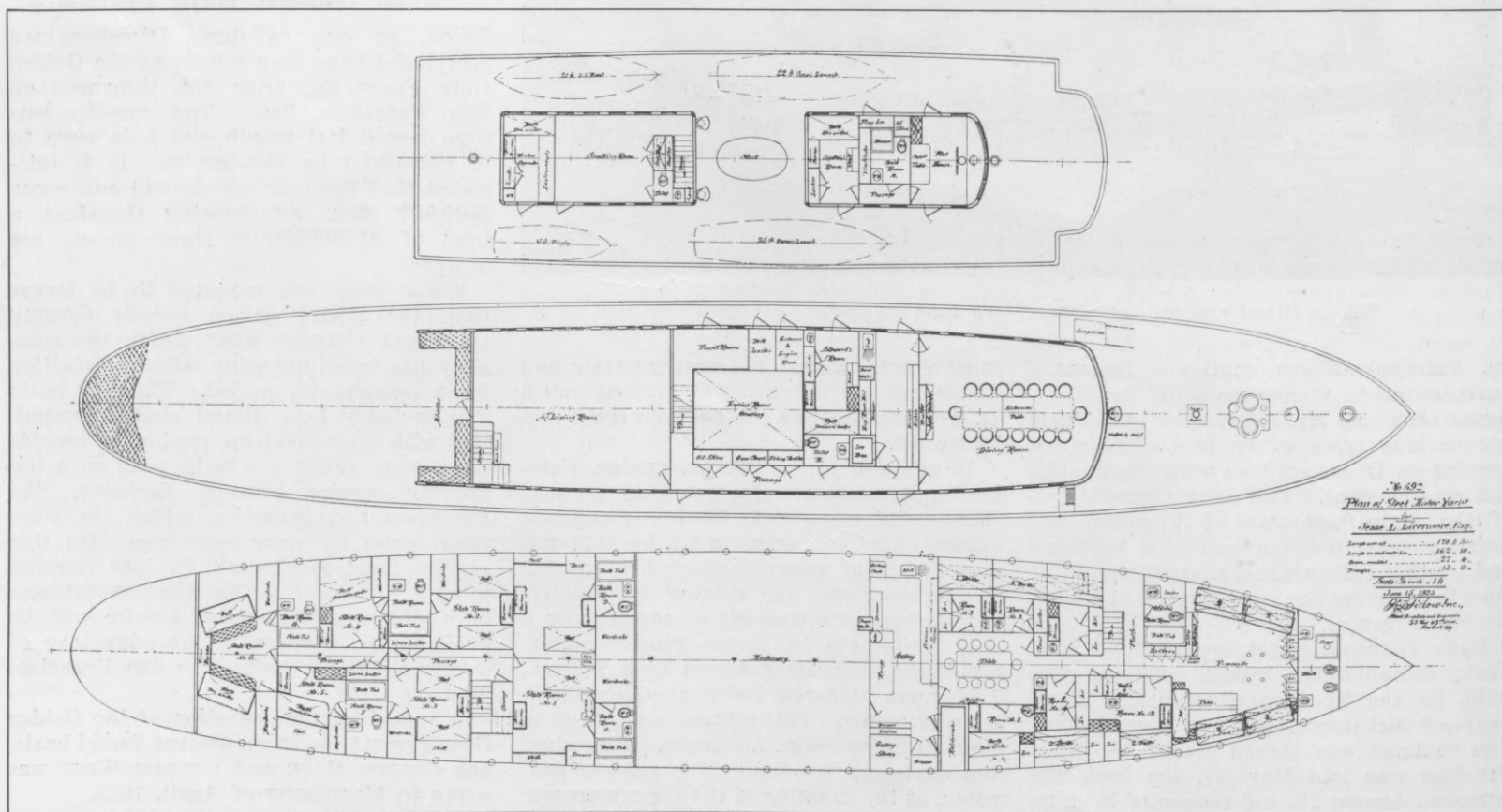
The upper deck is carried out over the house on the main deck to the sides of the ship, forming a big sun or promenade deck, approximately 85 ft. long by 27 ft. wide. On this deck are two teak houses, the forward one containing the pilot house and chart room with captain's stateroom and the after house to be used as a smoking room, with an inside passage down to the main deck and the radio room located in the after end.

The small boat equipment consists of a 26 ft. owner's sedan type mahogany launch, a 22 ft. crews' launch, two 21 ft. metallic lifeboats and a 15 ft. rowing dinghy.

In preparing the designs of this craft the architects had in mind at all times the conditions under which this yacht was to be operated. It would be used considerably commuting between the owner's summer home at Great Neck, L. I., and New York, but it was also necessary to remember the primary factor of seaworthiness and also ability to cruise around the world, because it is the owner's intention to take a world cruise next winter.

In the engine room there will be a pair of 6-cylinder Bessemer engines, developing 800 s.hp. at 250 r.p.m. There will also be two Bessemer generator sets of 30 kw. each, with a number of electric auxiliaries.

Fuel oil capacity will be sufficient to give an endurance of approximately 10,000 miles, with fresh water capacity for approximately the same distance.



Speejacks II Has Auxiliary Diesel Power

A 230 hp. Engine Drives Albert Gowan's New Schooner
Yacht at 12 Miles Per Hour

EXPERIENCE gained in his 37,000-mile cruise round the world three years ago in his yacht SPEEJACKS I has resulted in Albert Y. Gowan, of Cleveland, O., building a boat specially designed for off-shore work and will all the ability and comfort possible for this kind of cruising.

SPEEJACKS II, as she has been named, is an auxiliary schooner, designed by William H. Hand, Jr., and built by George Lawley & Son, at Neponset, Mass. She is of steel construction, the general design of the hull being quite similar to other Hand

reversible engine installed amidships under the deckhouse. This drives her under power alone about 12 m.p.h., with practically no vibration anywhere in the ship. She has fuel tankage for more than 5,000 miles under power alone. A 50 hp. Bessemer generating set of 25 kw. capacity, also has been installed. This provides power for the lights, winches, heaters, ventilators, Brunswick-Kroeschell ice machine, Sperry gyro compass and Sperry gyro-pilot (the Metal Mike).

This last piece of equipment is unique on

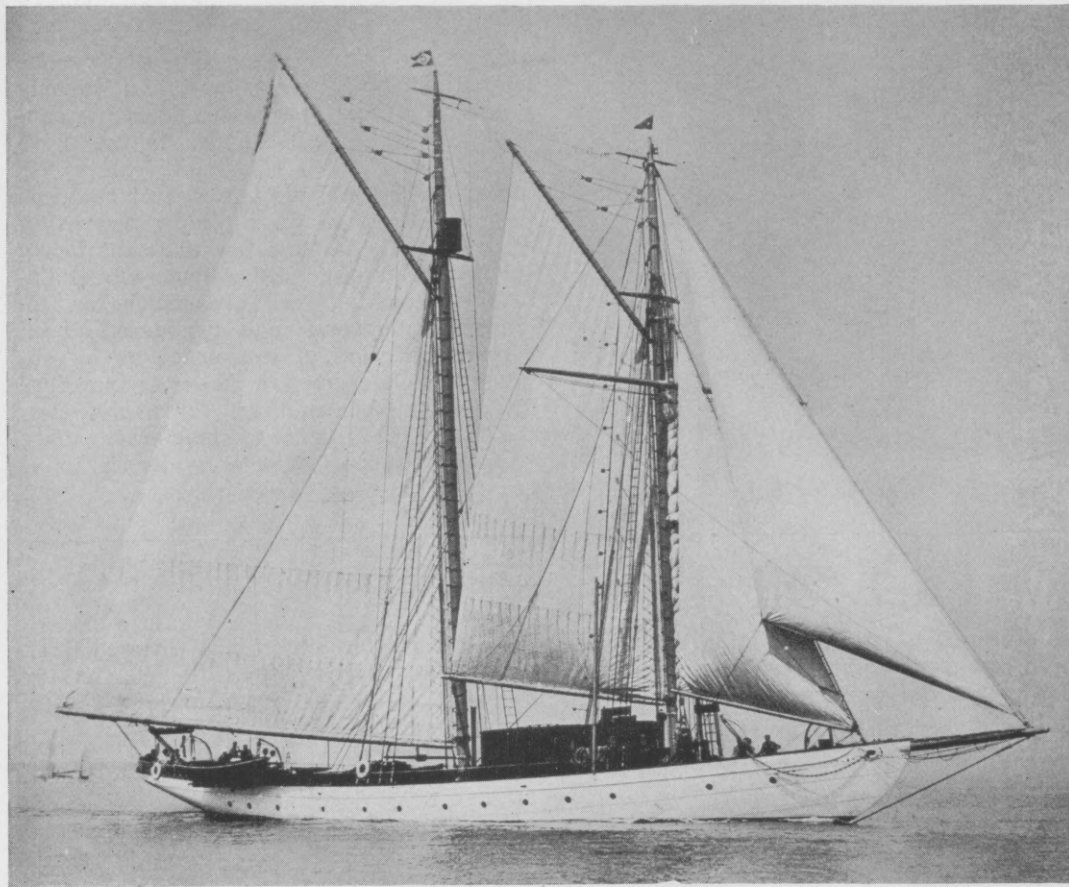
new course. In sailing to windward the ship is set on the nearest course she will sail to the wind. If the wind hauls or backs, a new course to meet the changed conditions can be set immediately.

SPEEJACKS II is most modern in every way. She has every convenience and every conceivable marine fitting to make cruising easy and comfortable. There is a ventilating system which will change the air in the entire boat every five minutes with all portholes, skylights and hatches closed. Blowers are used to force the air through a refrigerating plant to give cooled air ventilation. During the storms on his round the world voyage three years ago, Mr. Gowan and his party learned what it means to batten down all hatches, close all skylights and remain below in sweltering heat. With this new system of cooled ventilation, cruising in the tropics will be comfortable, even though the party is forced to stay below any length of time.

The radio equipment also is most up-to-date. It is in the deckhouse and is one of the most powerful obtainable. It was built as a duplicate of the set on the Leviathan and is capable of working 4,000 miles.

The deckhouse, which is a feature of the yacht, was at first claimed impractical by experts for a ship of this type. When Mr. Gowan heard of their objections, he took the approval of Lloyd's to the shipyard, together with a photograph of a 1905 schooner which still rides out South sea typhoons with two deckhouses.

The quarters for the crew are located forward. Aft the crew's quarters is the galley, connecting by a dumb waiter with the deckhouse above, in which is a dining saloon. The separate motor compartment is just forward of the main saloon, the latter being about amidships. The quarters for owner and guests occupy the after part of the ship, and include two double and three single staterooms, three bathrooms, toilets, and ample lockers and stowage space. A special oil-burning galley range does away with the necessity of carrying wood, coal or charcoal.



Lawley built yacht with auxiliary Diesel power for Albert Gowan

craft of the same type. However, there are several transverse watertight bulkheads which are not a common feature in a sailing yacht, with doors in them giving access to the various parts of the ship. The large deckhouse between the main and the fore-masts is also uncommon and a distinct advantage that should add much to the comfort of the yacht's occupants, especially on long voyages when rough weather can scarcely be escaped.

The new craft is 126 ft. long overall, 95 ft. on the water, 26 ft. beam and 14 ft. draft. She is a baldheaded schooner with two Marconi masts and spreads 6100 sq. ft. of canvas in her four lowers. She carries also a yard for a squaresail that trails into the mast on her fore. The rig is simple to handle, especially with the electric winches provided for operating the larger sails.

For auxiliary power the yacht is equipped with a 6-cylinder 230 hp. Bessemer directly

a sailing yacht. While the SPEEJACKS II may be steered from aft through the usual Edson screw gear there also is a wheel in the pilot house to which the gyro-pilot or automatic steerer is attached. These self-steerers are coming into extensive use on commercial craft, but this is the first that has been installed on a sailing vessel.

This automatic steerer operates in conjunction with the Sperry gyro compass. The vessel is put on her course on the gyro, the Metal Mike is set to work, and any deviation from the course, even if only one degree, is counteracted immediately by the rudder. In this way the steering is much more accurate than could be done by hand, where the helmsman cannot start to catch and meet the swing of the ship as soon as the automatic steerer can. If one desires to change the course quickly, as in navigation in crowded waters, the change is made on a small wheel some 6 in. diameter, and "Metal Mike" takes up the job again on the

CARITAS, designed by Cox and Stevens, and built by the Germaniawerft at Kiel, Germany, for J. Percy Bartram of the New York Yacht Club, arrived in New York last month after her transatlantic passage.

The yacht made a non-stop trip from Plymouth to Ambrose Channel Lightship, the actual distance covered being 3753 miles at an average speed of 11.2 knots. The dimensions of CARITAS are:

Length overall	156 ft. 9 in.
Length on waterline	147 ft. 0 in.
Beam	25 ft. 6 in.
Depth	14 ft. 2 in.

Her power plant consists of two Krupp engines of 250 hp. each. The fact that this new boat made so successful a voyage during the greater part of which a heavy sea was encountered, is a striking testimonial both to the reliability of her engines and to the excellence of her design.

New Steerer for Small Boats

A NEW type of electric steerer is being built by the American Engineering Co., Philadelphia, for use on small work boats or pleasure craft where the cost ordinarily might prevent the use of power steerers.

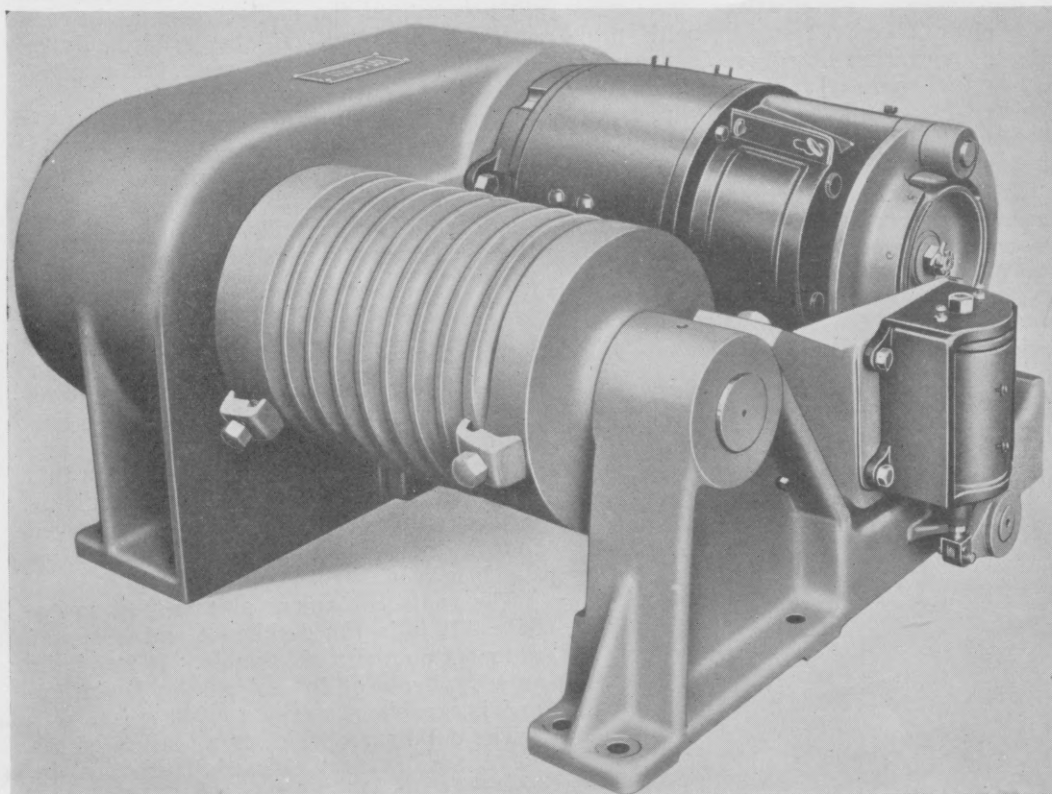
It consists of a very small, compact and efficient motor drive and a drum to take the rope from the tiller or quadrant. The gearing between the drum and motor is of the spur gear type and is totally enclosed, running in oil bath on roller bearings. The

control unit in the pilot house is a non-magnetic bronze column, with a wheel of bronze or inlaid mahogany with bronze hub and it consists simply of a motor controller operated by the wheel.

A slight turn of the wheel from the center position throws on the current in the motor, rotating the drum until the rudder is turned through the desired angle. Returning the wheel to the center position turns off the current. When the current is thrown on it passes through a solenoid which releases the holding brake as the motor starts. The moment the current is turned off the holding brake is automatically applied. This brake checks the motion of the rudder instantly and holds it at the desired angle until the wheel is turned again.

No current is consumed except when the rudder is being moved. The positive action of the steerer insures instant response to the wheel at all times and eliminates all drift or lag. The gear is a self-contained unit of the non-follow-up type and can be located wherever convenient. It is only necessary to run four wires from the control unit in the pilot house to the drive unit.

This is the first electric steerer that has been developed for that rapidly increasing class of boats which are a little too heavy for hand steering and cannot afford expensive installations. Inasmuch as an electric generator is now considered an indispensable item of equipment on oil engined boats, and electric power is therefore always available on them, the use of electricity for the steering of small craft cannot be held to be in advance of modern practise but is in keeping therewith.



Compact geared electric steering unit designed for small boats

New Fuel Oil Purifier

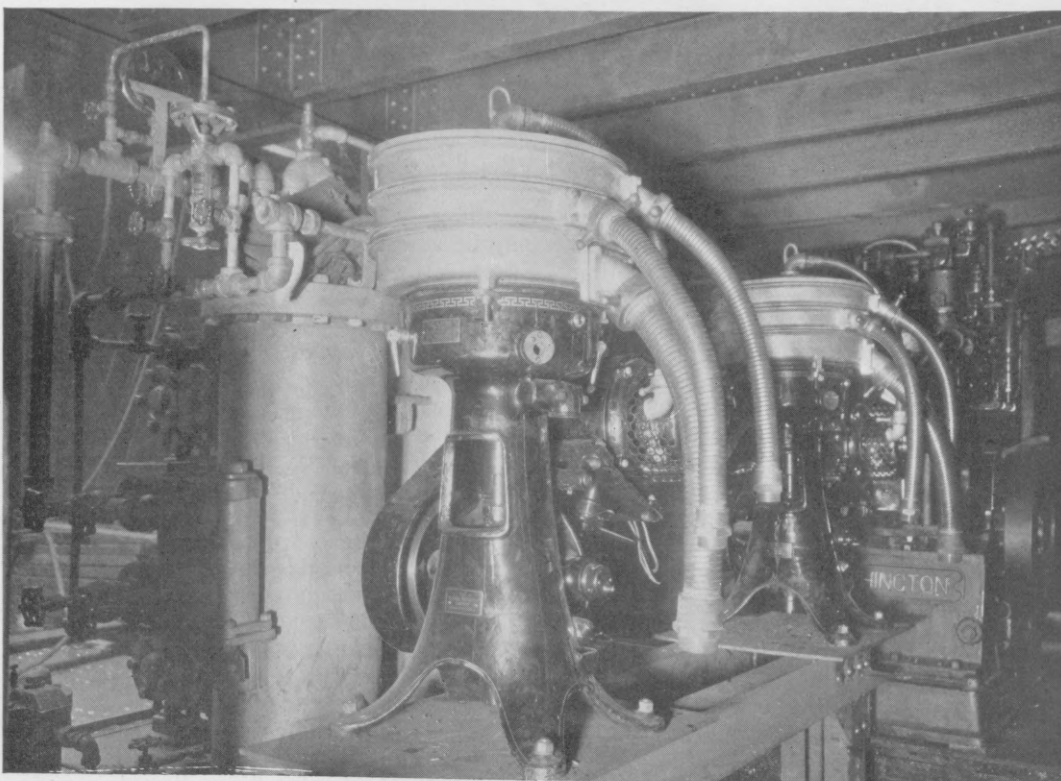
FOR the centrifuging of fuel oils that have to be heated in order to be fluid enough for use in the fuel lines of oil engines, the De Laval Separator Co. has introduced a new type of purifier which will be known as the Vapor-Tight model. It is identical with the standard type of De Laval purifier except for the cover, spouts and certain modifications in the discs, and with these exceptions the parts are interchangeable between the standard type and the new type.

The covers of the Vapor-Tight machine are made of cast aluminum, and the joints between them and between the bottom cover and the bowl housing or frame are gasketed. The covers are drawn tight by means of clamps. Once the covers are set in proper relation to each other, as regards the location of the spouts for any particular installation, it is unnecessary to loosen the clamps except to clean the inside of the covers occasionally.

The complete cover assembly is made fast to the frame with thumb screws, as may be seen in the picture showing the installation of one of the new centrifuges on the Ford Motor Company's vessel EAST INDIAN, which is now having her Sun-Doxford engines installed at Chester, Pa. The purifier intake is in the top of the upper cover and is made with a vertical nipple and horizontal elbow to which is attached a 2 ft. length of 1 in. flexible hose ending in a screw coupling. The elbow has an

eye designed to engage a lifting hook. All three discharge connections are made first with cast aluminum conversion pieces bolted to the sides of the three covers. To

these conversion pieces are screwed 2 ft. lengths of flexible hose, 1½ in. for the overflow and for the clean oil, and 2½ in. for the water spout.



New vapor-tight purifier installed on the Ford Motor Company's East Indian

Pumping Bilges Without Bilge Pumps

System Introduced by the Coast Guard Service for Salvage Work
is Now Utilized on New Craft

By Captain Q. B. Newman*

THE problem of pumping bilges on a steamship is very readily solved by the installation of a reciprocating steam pump, which is small in size and which costs comparatively little to purchase, install, and operate.

On motorships a reciprocating motion is not so readily obtained, and the plunger type of pump becomes more of a problem.

Boats now under construction for the Coast Guard at the Defoe Boat and Motor Works, the problem of pumping bilges appeared to be particularly difficult, and the solution finally arrived at was so simple that it is considered worthy of description.

There has been on the market for a considerable number of years a water jet ejector quite similar in principle and opera-

This type of ejector has been used by the Coast Guard in portable form for wrecking purposes; it will operate at a distance from the ship which is limited only by the length of hose available, and it has been found highly successful for this purpose.

The equipment on a 100 ft. Patrol Boat consists of one ejector in each of three compartments. The suction and discharge are 1½ in. and the pressure connection from the fire main is ¾ in. Control valves are in the engine compartment. The process of pumping bilges consists of starting the fire pump and opening the valve leading to whatever compartment it is desired to pump out.

On Coast Guard Cutter No. 44 (the NEW BEAR), the bilge pump equipment will consist of seven ejectors, one in each watertight compartment. The suction is 6 in., the discharge 6 in., and the high pressure connection 3 in. Each ejector has a capacity of 20,000 gal. per hour. There will be two fire pumps on the ship, and when it is necessary to pump bilges, one, or both, of the fire pumps will furnish the water required by the ejectors. In addition there are five ejectors with a capacity of 2000 gal. per hour each, which will be operated from the engine circulating system. For routine pumping of bilges the small ejectors will be more than adequate, and the large ones will be used principally for emergency conditions.

The advantages of the ejector are so marked that there seems scarcely room for argument as to its desirability. It eliminates the bilge piping system, which, with a centrally located bilge pump, is expensive to install, occupies considerable space, and is expensive to keep in effective operating condition. It eliminates the necessity for valves in individual compartments, which in case the compartment should suddenly be flooded, cannot be reached. It has no wearing parts to be destroyed by foreign matter in the water. It can be installed flat on a bulkhead or in bilges, and in either case occupies space which has little, if any, value. It requires no attention or adjustment. It cannot lose its suction or become air-bound. And finally, its cost is very low; the equipment listed above for the NEW BEAR, which includes foot valves and strainers, costs about \$2,200 for a potential pumping capacity of 150,000 gal. per hour.

Low Repair Costs

"The remarkable performance of the motorships CITY OF PANAMA and CITY OF SAN FRANCISCO is exciting much favorable comment on the Pacific Coast," recently stated the *Journal of Commerce*, New York. "In eight months the CITY OF PANAMA has required only a small welding job, costing less than \$5, and the upkeep record of the CITY OF SAN FRANCISCO is little, if any, less impressive." These ships were built by Götaverken for W. R. Grace & Co.

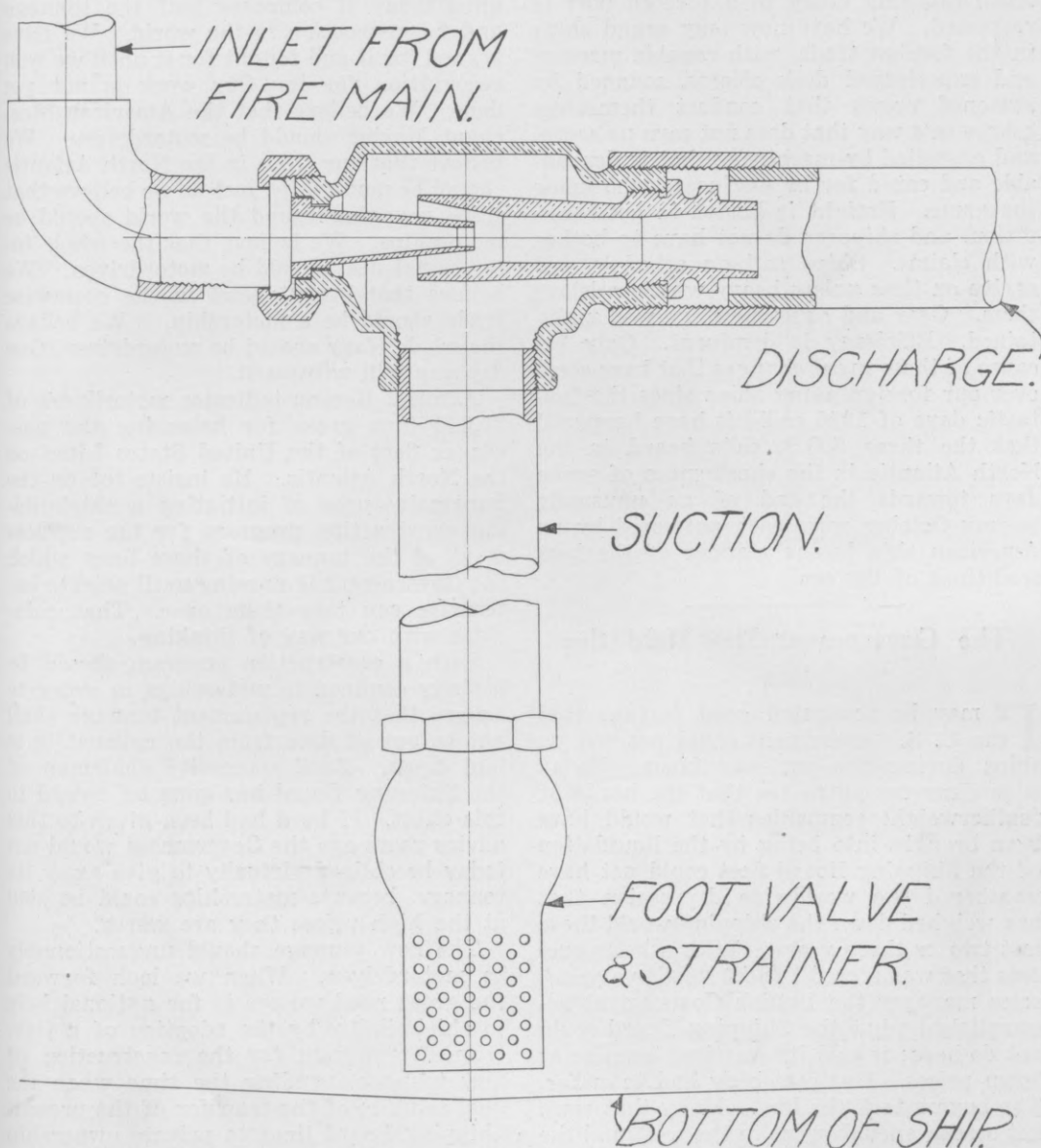


Diagram of bilge ejector adopted on all new Coast Guard boats

It requires an electric motor drive which is necessarily of such a speed that it must be geared down before reaching the pump. The pump with its motor, gears, crankshaft and connecting rods is quite expensive, both in first cost and in space occupied.

A vertical sump pump of the centrifugal type is quite satisfactory within the capacity limitations which necessarily exist, but it is frequently not practicable to install a pump of considerable capacity in this fashion.

In drawing plans for the 100 ft. Patrol

tion to the well-known steam syphon ejector, commonly found on steamships. The power is furnished by water from the fire main or from any other source where the pressure is 20 lb. per sq. in. or more. The water passes through an expanding nozzle to the discharge pipe. It creates a partial vacuum in the chamber which encloses the nozzle, and the vacuum thus created is sufficient for a lift of 10 ft. or 12 ft. The mixture of "power" water and bilge water passes through the discharge pipe and overboard. There is a combined foot valve and strainer at the lower end of suction pipe.

*Engineer in Chief, U. S. Coast Guard.

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American Shipping and American Commerce

OUR shipping business is of the first order of magnitude. It occupies a large fleet of vessels, and the traffic it handles gives employment to great numbers on our coasts. Over 6½ million tons gross of large American steam and motor vessels are active today, apart from the tonnage of power vessels of 1000 tons gross and under. About 275,000,000 tons of freight are moved on salt water and on the Great Lakes, and more than 450,000,000 tons of merchandise was moved across the piers last year in the classes of traffic we are considering.

When therefore the American Merchant Marine is mentioned it is no picayune affair that one must think of. Too often our people lose sight of the fact that American shipping is an actuality and not a political chimera. The unfortunate impression has been very widely spread that American shipping is no more than pork barrel dressing and that sensible men should not waste their time in thinking about it. The way to counteract that belief is to disseminate the knowledge that the whole country participates in the creation of a huge ship traffic.

Shipping is constantly becoming more important in its relation to the life and business of the country. Traffic between the East Coast and West Coast has been so enormously favored by the opening of the Panama Canal that one may be permitted to attribute not a little of the growth of the Pacific slope during the last decade to the existence of the intercoastal water route. The industrial development of the South has similarly been benefited by the coastwise ship services. The expansion of American commerce in South America and

across the Pacific has also been contemporaneous with the extension of American shipping lines to those parts of the world. The more we grow the more we need shipping.

If we do not use vessels for intercoastal and coastwise trade the freight must move by rail and commodity prices will be higher. In the last few years coastwise shipping has been stimulated by increased railroad rates and by the spread of business activities in the coast regions, particularly south and west. Brisker business has encouraged competition, and competition has fostered improvement of equipment and facilities. The coastwise shipping is destined to be replaced more rapidly than has been the fashion hitherto.

Our improved position in overseas shipping gives cause for satisfaction. An American ship today in a foreign port is respected. We have now only sound ships in the foreign trade, with capable masters and experienced deck officers, manned by seasoned crews that conduct themselves ashore in a way that does not earn us scorn, and propelled by machinery that is dependable and cared for by engineers who know the game. Freight is landed in good condition, and shippers do not have to bother with claims. Ships sail on schedule and arrive on time unless heavy weather delays them. Gear and equipment are well maintained. Efficiency is dominant. Only because of these great changes that have come over our foreign going ships since the fantastic days of 1920 could it have happened that the three S.O.S. calls heard in the North Atlantic in the short space of seven days towards the end of an unusually stormy October were each answered by an American ship in the manner of the best traditions of the sea.

The Government Has Held the Bag

IT may be accounted good fortune that the U. S. Government could not sell its ships during the post-war boom. Today it is clear for all to see that the horde of featherweight companies that would have been brought into being by the liquidation of the Shipping Board fleet could not have weathered the worldwide depression that has weighed down the shipping world these last two or three years. With a sales success that was a credit to its "dollar a year" sales manager the British Government accomplished what the Shipping Board could not do here: it sold its wartime tonnage at boom prices. But somebody had to suffer. The buyers took the loss. Many that were not strong enough went to the wall, and the low value of used tonnage in the world market today is due at least as much to after effects of the British Government's prompt ship sales policy as to the deferred sales policy of our own Government. Neither Government could really, however, have acted differently.

So it happens that we, as a nation, are now setting shipping companies up in business on a basis that seems to afford them financial security during the worst slump that shipping has ever known and which should therefore put them on velvet when shipping improves. The opinion may be held that we have been tardy, but hindsight leads us to believe that nothing permanently useful could have been accom-

plished before. We are gratified with the volume of our shipping business, the activity of our ports, the new spirit in our coastwise trade, the morale and efficiency of our ships in foreign trade and the progress in the sale of Government tonnage to private operators. We welcome what has been accomplished in the relatively brief time of a few years. We have confidence in the future.

Motorships and Aid to Shipyards

WE are always on the side of the motorship as the most modern and efficient instrument of shipping which this age knows. We have witnessed the changes it has wrought in the economics of shipping. We have seen it win its way forward until today it composes half the tonnage under construction in the world. We have argued for it and fought for it until we won recognition for it. Our work is not yet done. We believe that the American Merchant Marine should be motordriven. We believe that our ships in the North Atlantic should be motorships just as we believe that ships voyaging round the world should be motorships. We believe that the whole intercoastal fleet should be motordriven. We believe that every vessel in the coastwise trade should be a motorship. We believe the whole Navy should be motordriven. One day you will witness it.

Admiral Benson indicates motorliners of 30,000 tons gross for balancing the passenger fleet of the United States Lines on the North Atlantic. He insists too on the imperative need of initiating a shipbuilding construction program for the replacement of the tonnage of those lines which the Government is nursing until private enterprise can take them over. That coincides with our way of thinking.

Such a construction program should be entirely confined to motorships in order to ensure that the replacement tonnage shall not be out of date from the moment it is laid down. Each successive chairman of the Shipping Board has gone on record to this effect. If heed had been given to this advice years ago the Government would not today be obliged virtually to give away its tonnage, because motorships could be sold at the high prices they are worth.

The new tonnage should unquestionably be motordriven. When we look forward the great need we see is for national help to shipbuilding by the adoption of a Government program for the construction of new tonnage, pending the time when the final solution of the transfer of the present Shipping Board lines to private ownership shall have been successfully attained.

Only our consciousness of the vital importance of supplying shipyards with work enables us to condone the passenger steamers that are being contracted for by coastwise and intercoastal lines. Better that steamers should be ordered than no ships at all. At a time, however, when nearly all large and fast passenger liners building in other countries are motorliners the policy of discounting obsolescence and adherence to steam in new American ships, even though for service in the protected coastwise trade, is somewhat reminiscent of the disregard of steam and steel by the clipper owners of an earlier day—and you know that story.

Diesel Electric Power for Famous Bark

Commodore Arthur James' Aloha Will Have Her
Auxiliary Steam Machinery Scrapped

ALOHA, Commodore Arthur Curtis James' 3-masted square rigger, famed by several round-the-world cruises, is to have her auxiliary power converted from steam to Diesel-electric drive according to Tams & King, naval architects, who have been retained to supervise the new installation.

175 kw. generator and 30 kw. exciter. These units individually or collectively will supply power for the 640 hp. Westinghouse double armature propulsion motor and for the auxiliaries above and below deck.

The Westinghouse Electric & Manufacturing Co. exhibits at the Marine Show the pilot house control used to regulate the

anchor windlass, steering gear and boat hoist, built for Commodore James' yacht.

The principal dimensions of the ALOHA, which was built in 1910 by the Fore River S. B. Co. at Quincy, Mass., are:

Length overall	218 ft. 0 in.
Length on waterline	165 ft. 10 in.
Extreme breadth	35 ft. 6 in.
Depth	17 ft. 0 in.
Registered length	180 ft. 0 in.
Registered beam	35 ft. 6 in.
Registered depth	17 ft. 0 in.
Net tonnage	329 tons
Gross tonnage	659 tons

The new propulsion equipment is the lightest of its kind ever built, and by a well considered distribution of its weight will give the ALOHA better trim, besides increasing her speed and endurance under power.

Forty-two separators have been ordered by the Shipping Board for the 14 steam-to-Diesel conversions. Twenty-one will be supplied by the De Laval Separator Co. and twenty-one by the Sharples Co. In each ship two of the centrifuges will handle fuel-oil and one will purify the lubricating oil.

Rivers and Harbors Congress

Nearly 500,000,000 tons of commerce valued at \$22,000,000,000 was carried last year on American coastal or inland waters, according to the statistics compiled by the National Rivers & Harbors Congress which will hold its 21st Convention at Washington, D. C., on Dec. 9 and 10. This body advocates the improvement of rivers and harbors, the adequate maintenance of which requires about \$17,000,000 a year and the improvement of which, under projects already authorized, will require \$250,000,000. The amount of work that can be done during the next fiscal year will be determined by the size of the appropriation made at the next session of Congress. Funds available for further work will be almost entirely exhausted at the end of the present fiscal year. The Army Engineers retain a few million dollars to provide for unforeseen emergencies, but that money has only been retained by stopping work entirely on some projects and slowing up the work on all the rest.

In 1922-23 Congress discarded the amounts recommended by the Bureau of the Budget and voted the full amounts asked by the Army Engineers, the total for the two years being \$100,000,000. In 1924-25 Congress did not go beyond the amounts recommended by the Bureau of the Budget and in those two years voted only a total of \$77,000,000. Congress will only appropriate money if the representatives and senators are convinced of the great importance of adequate river and harbor appropriations, and to stimulate voters to make recommendations to the Representative of their district or Senators from their State is one of the biggest efforts of the National Rivers and Harbors Congress.



The square-rigged Aloha will have Diesel electric auxiliary power

Delivery of the Diesel-electric equipment happened to coincide approximately with the time of the American Marine Exposition and the various builders of the machinery requested permission of Commodore James to exhibit it at the Exposition.

The new propulsion equipment for the ALOHA consists of three 275 hp. Winton engines, each connected to a Westinghouse

speed of the double armature propulsion motor in either direction from zero to 180 r.p.m. and the dead-front switchboard, propulsion motor, one generator and an exciter for the installation.

The Winton Engine Co. is showing one of the three 275 hp. Winton engines, built for this installation, and the American Engineering Co. exhibits the electric hydraulic

Cylinder Lubrication Accurately Timed

New Model Lubricator Manufactured by Old Firm Is Specially

Designed for Oil Engine Work

By A. B. Newell

IT is quite universally agreed that there is a decided advantage in having the oil to lubricate the cylinders of oil engines delivered to the pistons at a definite point in the stroke, preferably between the rings at or near the end of the stroke.

This timing is particularly important for engines in which the oil holes are uncovered on the upstroke of the piston, for, should the oil be forced into the cylinder at a time when the piston did not cover the point of discharge,

line from the instant the oil leaves the reservoir until it reaches the point to be lubricated, the sight glass being filled with glycerine or water through which the oil passes on its way to the cylinder. There is no possibility of air pockets forming, time of delivery changing or of any variation in the amount of oil supplied.

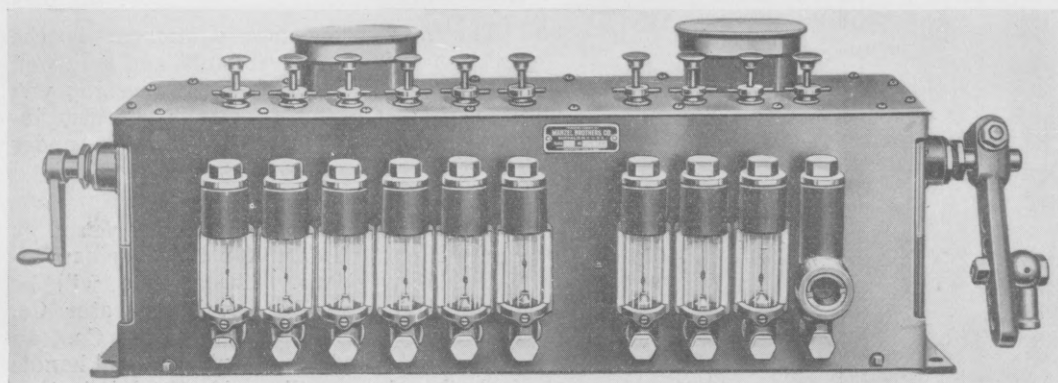
The lubricators are built on the unit principle, with a number of individual pumping units in a central tank or reservoir, with one

discharge of oil at every stroke of the pump plunger, although the sight glass may show an interval between drops leaving the oiler nozzle.

At first glance it may seem as though a considerable space of time elapses between drops of oil reaching the cylinders, but this is really not the case. It may take eight or ten strokes of the pump plunger to build up one drop sufficiently large to leave the nozzle and pass through the liquid, but as the fluid cannot be compressed it is obvious that one-eighth or one-tenth of a drop of oil is discharged at the point of lubrication at each stroke. As the pipe line is full and there is no leakage, an amount equal to the amount forced in by the plunger must go to the point being lubricated, otherwise the pipe or glass would burst. A wire in the center of the glass guides the drop of oil and prevents it from drifting off the glass.

By pushing down on the head knob each unit of the lubricator may be operated by hand. This forces the maximum amount of oil to the point to be lubricated. The operation may be repeated as often and rapidly as may be needed if the object be to flush the cylinder. By turning the small crank all of the units may be forced simultaneously. The adjustment of the mechanism is not changed in any way as the result of the hand operation.

Other interesting and important features have been incorporated in this new design. The cams which operate the plungers are sharp, giving a quick action and the actual working stroke only requires 45°, which means that if the shaft were turned at engine crankshaft speed oil could be definitely delivered to the piston during the period of 22.5 deg. before, plus the same period after, bottom center of the engine crank throw.



Sight glasses in the pressure lines show oil feed to cylinders

a considerable portion would be wasted, necessitating the use of a larger amount of oil, while at the same time an element of uncertainty would exist as to how much oil was reaching the point to be lubricated.

On 4-cycle engines it is desirable that the lubricator should be timed to inject the oil into the cylinder when the piston is at the end of the working stroke. The piston will then make two strokes with very little pressure and one stroke under pressure and spread oil over the entire surface of the cylinder walls before combustion occurs.

By proper timing of the oil injection, wear on the pistons, rings and cylinders may be materially reduced while carbonization will be eliminated to a great extent. This is not so much the case with engines of the trunk piston type, with pistons so long that the point of injection is constantly covered, in so far as the cylinder walls are concerned. But many of these now in use depend upon the transfer of oil from an opening in the cylinder wall to a recess in the side of the piston, for piston pin lubrication. Timing in this instance is vitally important.

Mechanical lubricators which meet these requirements have been manufactured abroad for a number of years. Others manufactured in America have been timed, but despite this a certain element of uncertainty as to when the oil would reach the point of delivery has existed, due primarily to the fact that a solid column of oil was not maintained between the pump and the end of the pipe.

When air was drawn into the pumps it was in turn delivered into the pipes and formed a cushion. With different lengths of pipe and different proportions of oil and air mixed within these it naturally followed that the time of delivery was uncertain, regardless of how the stroke of the pump was timed.

Manzel Brothers have now introduced a type of oiler designed primarily for timed lubrication. The design insures a minute quantity of oil being forced into the cylinders at each stroke of the pump plungers.

There is a solid body of fluid in the oil

complete unit for each cylinder point to be lubricated.

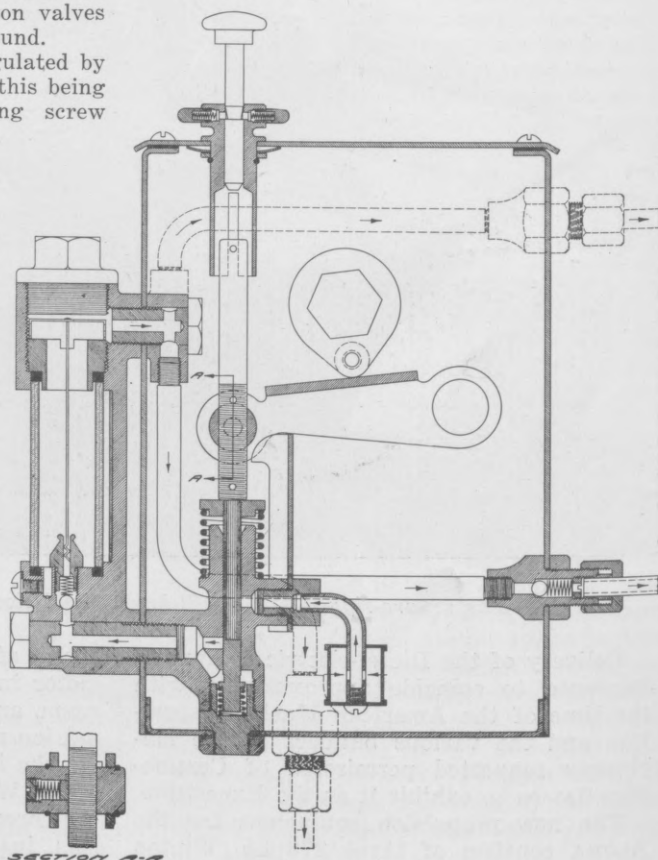
Each unit consists of a single plunger pump, operated by a cam on the driving shaft, which may be driven by a ratchet rotary or direct lever movement, obtained in the usual manner from the camshaft or other moving part of the engine.

No intake valves are used, the plunger itself opening and closing the intake port and measuring out the amount of oil to be supplied. The piston valve opens and closes the outlet port. The plungers and piston valves are made of steel, hardened and ground.

The amount of oil supplied is regulated by raising and lowering the cam lever, this being adjusted by turning the regulating screw which is independent of the plunger.

On the up stroke of the plunger oil is drawn through the strainer and port by way of the pipe shown, and into the pocket directly underneath the plunger. It will be observed that the piston valve has a shoulder which prevents the spring from lifting it the entire length of the plunger travel, thus forming the pocket just mentioned. As the plunger is pushed down by the cam lever, the amount of oil measured out by it is pushed down, opening up the piston valve, and is then forced through the glycerine or water which fills the sight glass.

The heavy coil spring then returns the piston to its original position and the piston valve is in turn closed by its spring, thus preventing oil from returning to the reservoir. As the oil is forced forward by the plunger, it passes through the sight glass, which is, as mentioned above, filled with glycerine or water. Consequently there is a solid body of fluid in the oil line from the instant the oil leaves the reservoir until it reaches the point to be lubricated. This insures a



Cross section through lubricator

The cams of the pump may be placed on the shaft at any desired angle to correspond with the position of the engine cranks, thus a single lubricator may be made to serve any number of cylinders on the same engine without interfering with the important element of timing.

While the entire mechanism is primarily designed to lubricate engine cylinders, its own lubrication has been taken care of automatically by having all working parts in oil.

This lubricator is not intended to displace the earlier models, but is built primarily to fill a wide open gap, which has apparently been overlooked or underestimated by American manufacturers heretofore.

While the MANZEL will no doubt deliver oil to the cylinders or any other point of the en-

gine at a definite time we nevertheless feel constrained to warn the user against a common mistake in the application of oil, which the best lubricator in the world could not overcome.

It sometimes happens that the oil is delivered to an opening in the cylinder wall at a definite time, but the opening is so large and so deep that the oil must flow of its own accord— $\frac{1}{2}$ in. or $\frac{3}{4}$ in. This obviously defeats the object of timing. For this reason we feel that Manzel Brothers Company will materially help the future of this lubricator by insisting that it be installed in connection with a suitable fitting which will carry the oil as close to the point of application as may be effected without the fitting making actual contact with the piston.

Exhaust Valve Experiments

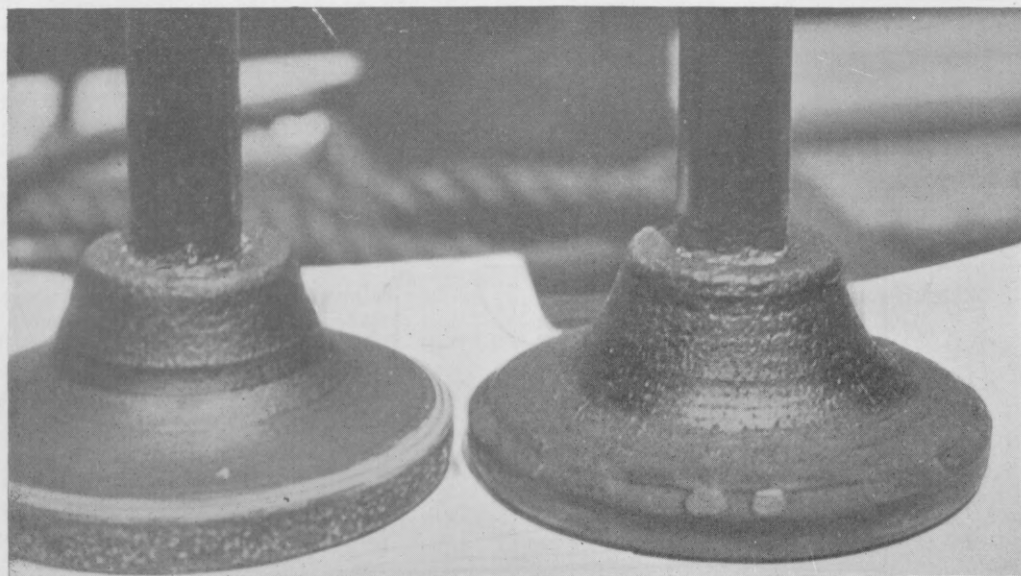
FURTHER information on the Hinsch type exhaust valve has now become available. The U. S. patents have been granted, and foreign patents are pending.

A. O. Hinsch, formerly chief engineer of the m.s. DONNA LANE, explains the detail and theory of his multi-seat valve in the following way:

"After spending hours of time thoroughly overhauling a valve of the usual type and putting it back in the engine, the valve remains good only so long as the scale which forms on the seat remains unbroken. The scale, however, does not remain in such a state. After a time it shows signs of chipping off and breaking up in places, and when this happens it allows the hot gases of combustion to blow by the face of the valve and cause pitting and burning of the seat, etc.

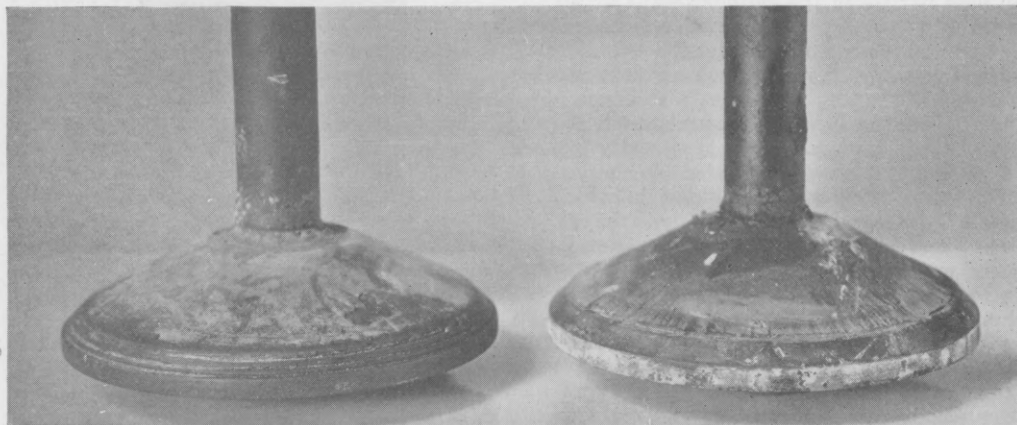
"The thing to aim at in attempting to correct this fault is either to prevent the scale forming at all or to have some means of retaining it in an unbroken state.

"The latter purpose can be achieved by grooving the valve face, forming thereby a series of narrow seats. Until the time comes when these grooves fill up solid with the scale, the valve faces act as chipping hammers, etc., preventing the formation of the scale in a wide seat. Later, when the scale finally fills the grooves up completely, it will have formed a complete false seat of scale only. As this scale has a tendency to chip off likewise and break up, a means must be present to counteract this tendency. This is what the grooves accomplish by acting as foundation anchor holes, etc. Consequently the scale is broken off a little at a time, more of it forms, and it finally comes out with a perfect seat."



Grooved valve on left contrasted with standard valve from same engine

These valves were first mentioned in our April issue, under the heading "Defects of m.s. CARRISO eliminated by overhaul." It was there reported that the Hinsch valves fitted to the engine of that vessel were standing up far better than the standard valves had done.



On left, new grooved valve and on right, grooved valve after use

Lately we found Chief Engineer Jensen of the BOOBYALLA trying out the same type of valve. Encouraging results have been obtained, but the period of trial has not yet been long enough to permit judgment to be passed upon the value of the Hinsch type.

A picture on this page shows one of this ship's Hinsch valves, with two months' service to its credit, alongside a standard exhaust valve that had been used for about three months. The Hinsch valve on the left has the regular cast iron head and steel stem, but

Exhaust Valve Experiments (Continued)

around its face are cut two grooves about $\frac{3}{64}$ in. deep, which were lined with chalk to make them show up in the photographic reproduction. On the right is the standard type exhaust valve. Contrasting the two valve faces one notes that the standard valve shows severe pitting whereas the Hinsch valve is as good as new. Once a valve gets into the condition shown by the standard valve in this illustration the face burns away rapidly due to flame blowing past.

In another illustration are shown an almost new Hinsch valve and another valve of the same type from the m.s. CARRISO after the grooves have been filled up with scale. Both valves give evidence of salt incrustation, indicating the probability of salt water in the fuel and consequent increased valve wear. Nevertheless the valve on the right, with its grooves filled, shows substantially no sign of pitting.

Other vessels—for instance, the ADMIRAL PEARY—are trying out this type of valve, and before many months are passed there may be sufficient information available to indicate whether the early expectations are fulfilled, whether all cases are alike or whether only certain conditions are favorable.

Civil Service Vacancies

Two of the naval establishments are in need of draftsmen in connection with naval construction authorized by Congress last winter. The New York Navy Yard, which will build a 10,000 ton scout cruiser, needs 5 ship design draftsmen, 14 ship detail draftsmen and 10 copyists. Ship draftsmen are also needed at the Norfolk Navy Yard, and draftsmen qualified in aeronautical work are being sought by the Naval Aircraft Factory at Philadelphia.

Receipt of applications for junior engineers qualified in naval architecture and marine engineering will close November 14th. The examination is to fill vacancies in various branches of the navy service throughout the United States. The entrance salary is \$1860 a year, which can be advanced without change in assignment up to \$2400 a year.

In both cases full information and application blanks may be obtained from the U. S. Civil Service Commission, Washington, D. C.

Useful Maxims

Strange how the man who blows the hardest about how he will work if he gets a job is the first one to kick when he has to work hard.

Roller contact may tell when the fuel valve opens and again it may not. Best set with air and then indicate.

A leaking starting valve makes the starting air line get hot.

A grounded deck circuit should be taken care of in good weather even if it is troublesome only when it is wet.

Never shut off the maneuvering air at sea.

Sketches and Working of Oil Engines *

Crosshead Function of the Trunk Piston Considered in Relation to Structure, Heat Conditions and Wear

MANY of the considerations applying to crosshead pistons hold good for trunk pistons, but the latter are further required to perform the function of resisting the connecting rod side thrust, or in other words act as a crosshead. Whereas there are only two functions for the crosshead piston, the trunk piston must perform three: 1. act as a moveable pressure seal, 2. transmit the driving force of the engine, 3. act as a crosshead.

In some of the earlier designs of crosshead oil engines, it was thought necessary to make the piston long in order to guide it in the bore, on the assumption that the guiding effect of the crosshead was not sufficient.

In the same way some horizontal and vertical steam engines are still provided with tail rods, such as the one illustrated in Fig. 98. Since the clearance round the piston rods passing through the stuffing boxes is kept smaller than the clearance of the piston in the bore, the piston does not touch the cylinder walls at all. No wear can therefore be caused on account of the body of the piston rubbing the cylinder, and the only wear found in such an arrangement is due to the friction of the piston rings. Because of this feature the amount of oil fed for lubricating purposes can be greatly reduced, an advantage of considerable importance for condensing steam engines, in which the condensate is returned to the boilers.

In Fig. 89 of the preceding chapter are illustrated crosshead pistons with fairly long guiding surfaces in spite of the fact that a crosshead is provided. There are a number of engineers who consider so great a piston length unnecessary. As was also brought out in Chap. VIII, there seems to be ample support for the belief that most of the cylinder wear is due to piston ring friction in the case of a crosshead engine. In Fig. 79 of Chap. VIII was reproduced a diagram B clearly showing the coincidence of the region of maximum cylinder wear with the high pressure parts of the indicator card. Reference to Fig. 86, also of Chap. VIII, makes it possible to realize vividly how the large flat sliding surface of the crosshead shoe effectually guards the cylinder liner from wear other than that caused by the gas pressure behind the piston rings.

It is almost superfluous to remind engineering students of the fact that the connecting rod of any engine, be it of the crosshead or trunk piston type, exerts a very appreciable side thrust as will become readily apparent from an inspection of Fig. 99.

As the piston recedes from the upper dead center on the expansion stroke, the connecting rod at first occupies a position very nearly parallel to the center line of the engine and exerts only a small amount of side thrust, but the latter rapidly increases as the position of the rod becomes more and more oblique. There is a definite percentage of the total direct piston load communicated as side thrust for each percentage of stroke; the maximum proportion of piston load which can be thus exerted in a sidewise direction occurs when the connecting rod and the crank are at right angles to one another. This happens when the crank is advanced from 75 to 80 deg. from the top dead center. Since the connecting rod may be considered as being freely jointed both on the crank pin and on the wrist

pin, the forces transmitted by it must always lie along its own center line. By a process of reasoning based on the theory of statics, which need not be investigated in detail at this point, it is easy to show that the force in the con-

necting rod must at all times be the combination of the side force on the crosshead and the direct force coming from the piston. The ratios of direct force to side force have been tabulated and are available in engineering handbooks, and it will be found from an inspection of such tables that the maximum value of the ratio occurs at a crank angle of about 77 deg. as already mentioned. While

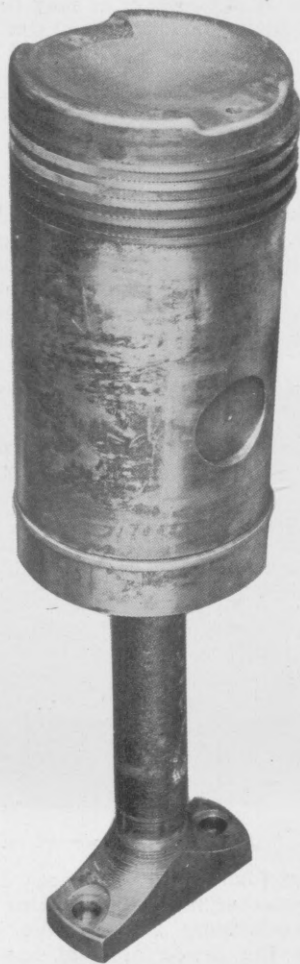


Fig. 97. Trunk Piston

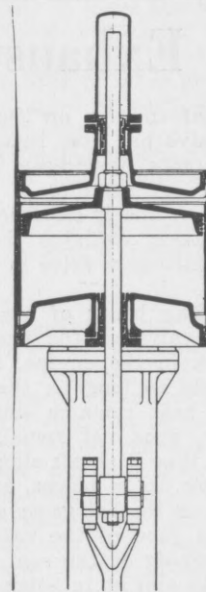


Fig. 98. Piston with tail-rod

the connecting rod is assuming the various positions referred to above, the pressure on the piston is varying in the characteristic manner depicted by the indicator card. It will be recalled that the full pressure of 500 lb. per sq. in. remains undiminished until about one-tenth of the piston stroke has been traversed. After that point, however, which corresponds to a crank angle of about 40 deg., the pressure falls very rapidly. All the time the proportion of piston force transmitted to the crosshead is increasing, but as the direct force of the gases is rapidly diminished their availability as side pressure on the crosshead suffers a net decrease in spite of the increasing obliquity of the connecting rod.

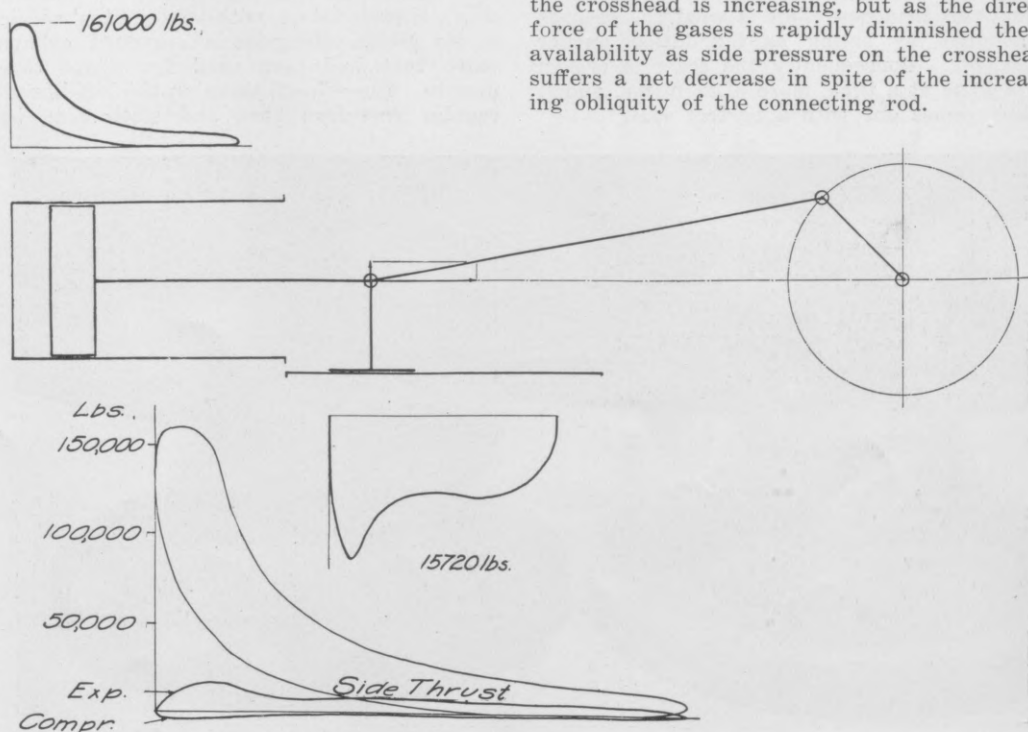


Fig. 99. Side thrust diagram and indicator card

*Summary of a Course of Instruction at the Polytechnic Institute of Brooklyn, N. Y., by Julius Kuttner, B.Sc., Licensed Chief Engineer, Editor of OIL ENGINE POWER and Associate Editor of MOTORSHIP. This is the tenth chapter, the first one having appeared in the January, 1925, issue.

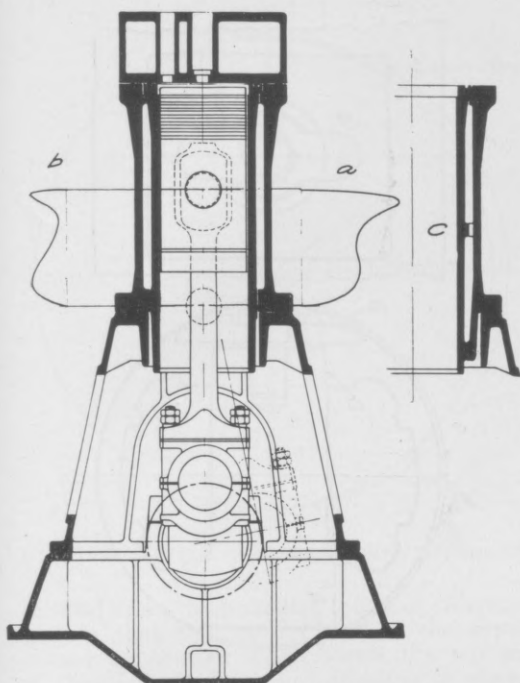


Fig. 100. Trunk piston engine and side-thrust curve

The maximum product of side force ratio and piston pressure is reached approximately after one-tenth of the stroke has been traversed. At that point the 15,720-lb. peak of the crosshead load will be found; the values given apply to an engine with stroke and bore dimensions of 20 in. x 30 in.

It is to be remembered, of course, that the pressures shown by the indicator card cannot be employed for calculations of this kind without correcting them for inertia. As the piston is being started from rest off the top dead center, a large share of the gas pressure force is used up in overcoming the momentum of the piston and the reciprocating parts thereof, and all of the force expended for this purpose naturally is unavailable at the crosshead pin. In some ways it is a lucky thing for oil engine practice that such should be the case, because it is readily apparent that the decrease in gas pressure force while the peak of firing is in progress tends to relieve the bearings of excess pressure. As the piston approaches the bottom dead center the reverse process takes place, and the slowing up of the piston creates a certain amount of extra force on the crank-pin which tends to keep it turning in spite of the greatly reduced gas pressure. The diagram shown in Fig. 99 is corrected in this way. It is based on a piston of 20-in. diameter which sustains a load of 161,000 lb. directly along the cylinder axis. The peak of the side thrust works out as 15,720 lb. and as a general rule it will be found to lie in the neighborhood of 10 per cent of the maximum gas pressure in engines as commonly designed. The latter figures, of course, include the inertia correction. As the speed and weight of the reciprocating parts are increased the effective inertia becomes more pronounced and relieves the crosshead more and more from the peak of the side thrust.

In Fig. 99 are curves showing direct piston pressure (indicator card), and the curve of side thrust corrected for inertia is also plotted. Although it is thus apparent that the side thrust is small as compared with the maximum direct thrust, it nevertheless takes on a maximum value around 15,000 lb., sufficient to cause wear in a sidewise direction.

With these facts concerning side thrust in mind, it will be more readily possible to estimate the conditions which affect the working and wear of trunk piston engines in which no crosshead is provided and in which the piston must also act as the crosshead.

The piston may be considered as a cylindrical crosshead similar to those used on some

double-acting steam engines. In such machines advantage is taken of the fact that the bore of the circular crosshead may be made at the same setting of the boring bar as that used in machining the cylinder surface, automatically insuring alignment. In Fig. 101 is shown the evolution of the trunk piston into the cylindrical crosshead or the reverse, depending upon the point of view. It is apparent there that a trunk piston can readily be converted into a crosshead simply by eliminating the metal in the way of the wrist pin bosses and by chopping away that part of the cylinder which cannot usefully take up any side thrust. It would be equally reasonable also to make a trunk piston out of a cylindrical crosshead by continuing the guiding surfaces around until they form a complete cylinder and by doing the same thing with the trunk piston barrel. In the case of a flat crosshead like that shown in Fig. 86, all of the surface is available for taking load, whereas in the case of a cylindrical crosshead like that shown in Fig. 101, only that part of the cylindrical surface which comes fairly near to being at right angles to the direction of thrust is of any use for taking load. It is

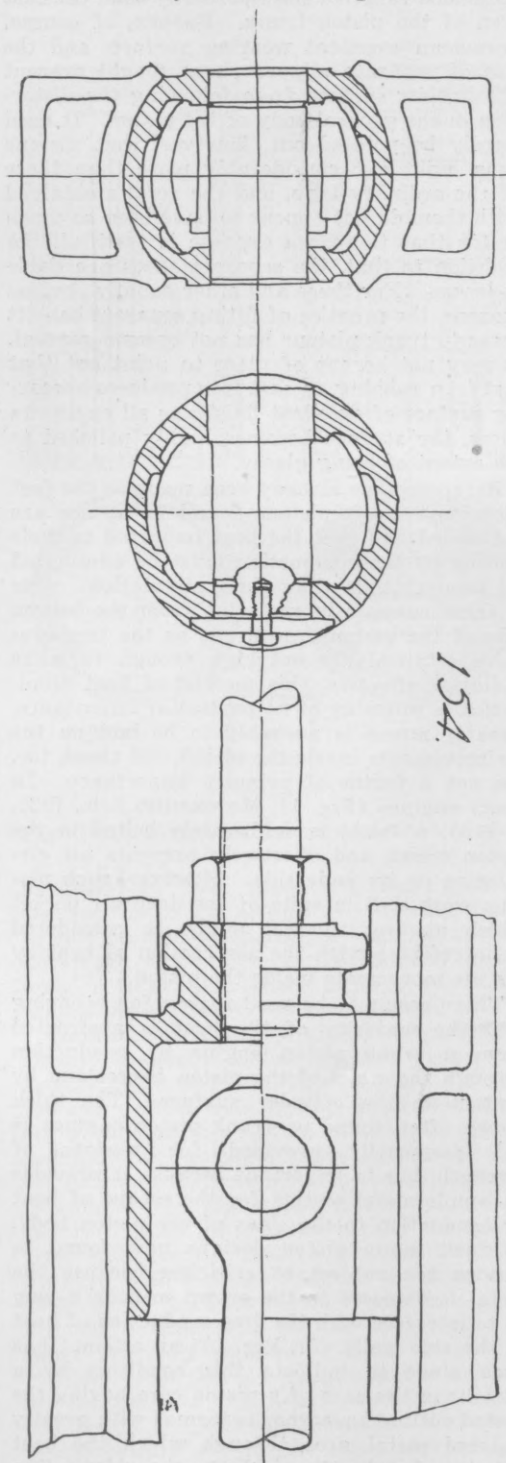


Fig. 101. Cylindrical crosshead and trunk piston section

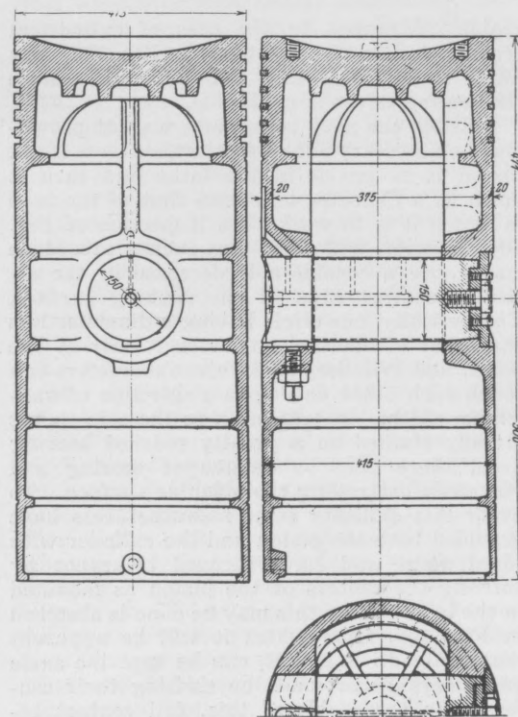


Fig. 102. Normal piston cross-section

obvious that those portions of a cylinder approximately parallel to the direction of thrust transmission can be of little value in taking up forces.

In Fig. 101 it is particularly obvious that the use of a trunk piston in place of a separate cylindrical crosshead greatly shortens the engine and reduces its weight and cost. As will be apparent shortly, the union of the crosshead and pressure sealing function in one and the same machine element cannot be done without admitting certain compromises. What these are, and how they affect the running of the engine and its commercial availability, will also be made clear as this study progresses.

An interesting attempt to avoid the use of a crosshead and at the same time to realize its advantages is illustrated in Fig. 103. It is there apparent that practically all of the side thrust is taken up by the massive swinging links while the piston rod—joined in a short piston—swings through so slight an angle that it exerts practically no side thrust at all. The arrangement does not permit of shortening the engine as compared to one of the standard sliding crosshead designs. It does, however, allow pairs of cylinders to be placed close together and to employ only one crank and connecting rod for them. Shortening of the engine and a reduction in its weight are said to be made possible by this arrangement; on the other hand, there does not seem to have been any marked extension in its use since the time when it was first brought out.

Possibly the greatest advantage from the use of trunk pistons and the elimination of the crosshead are realized in cylinder sizes which do not require piston cooling other than that provided by air circulation. As has already been noted, the fitting of a cooling gear to trunk piston engines is not an altogether straightforward job, but when crossheads are used the accommodation of the piston cooling tubes and other equipment is considerably simplified.

On account of this fact trunk pistons are generally found in sizes below 17 in. diameter. As the size is increased beyond this, cooling becomes necessary and the advantages of using a crosshead are so pronounced that the trunk piston is not so frequently found in the larger diameters. Trunk pistons of the uncooled type run at higher temperatures than those of crosshead engines. Up to 800 deg. F. has been measured on the crown of 4-cycle trunk pistons. On account of the higher temperature and the consequent expansion of the metal, trunk pistons must be fitted with consid-

erable clearance. In the case of cylindrical crossheads like those sketched in Fig. 101, very much smaller clearance can be used because the sealing effect is negligible.

Possibly the most convenient way of providing the necessary running clearance on a trunk piston is to put it in the lathe and turn it down to a diameter less than that of the bore in which it is to work. An inspection of Fig. 104, however, will show that such a procedure may cause a considerable decrease in the effective contact area of the rubbing surface. Theoretically, one circle having a diameter less than that of another can touch it only at one point, and cylinders of different diameters can touch each other only on a single line of vanishing width. In transmitting the side thrust already studied on a greatly reduced bearing area, there may be danger of scoring and otherwise destroying the machine surface. To avoid this difficulty some manufacturers have provided both the piston and the cylinder with equal radii and have secured clearance by shifting the centers of the piston as mounted in the lathe. How this may be done is sketched in Fig. 105, from which it will be apparent that the radii R and R_1 can be kept the same and clearance provided by shifting their centers. As the result of this, full contact between the piston and the bore is preserved.

On the other hand, the advantages secured by it do not seem to have justified its general

adoption by oil engine builders. There are too many other uncertain factors affecting the way of pistons. Warping and expansion produce other changes in shape than a mere increase in diameter, as is indicated by the methods of bedding in pistons practiced in some engine building shops. After short runs under power the newly assembled engine is taken apart and the piston examined for high spots which show signs of bearing hard. The latter are then dressed down with files or abrasives, the piston put back into place and the engine run again for another period of time. Repetitions of this process gradually bring the piston to a true bearing under the running conditions which will be met in service. Although this procedure has not by any means been universally adopted, it does indicate that attempts to get good piston bearing by an artificial procedure like that of eccentrically shifting lathe centers would be subject to certain drawbacks.

Other manufacturers have tackled the problem in a different manner as indicated by Fig. 106. In the piston shown there, babbitted slipper shoes have been provided to perform the crosshead function more perfectly than the cast iron of the piston trunk. Babbitt, of course, forms an excellent wearing surface, and the use of separate slipper shoes should prevent the babbitt surface from following the distortion in the general body of the piston. It need hardly be pointed out, however, that pistons thus built cost considerably more than those of the ordinary type, and the results obtained with them do not appear to have been so much better that the extra expense is justified. In addition to that, the separate shoes are liable to loosen. For these and other equally obvious reasons, the practice of fitting separate babbitt shoes to trunk pistons has not become general. It may not be out of place to point out that cast iron rubbing on cast iron produces a wearing surface of excellent finish; as all engineers know, the surface becomes highly polished to the extent of being glassy.

Reference has already been made to the fact that most trunk pistons found in service are not cooled and that the heat imparted to their crowns by the combustion must be eliminated by means other than fluid circulation. One of these consists in radiation from the bottom side of the piston crown, but as the temperatures attained are not high enough to make radiation effective, this method of heat elimination is probably of no particular importance. Greater stress is probably to be laid on the air movements inside the piston, but these, too, are not a factor of primary importance. In many engines (Fig. 11, *MOTORSHIP*, Feb., 1925, p. 119), a shield is deliberately bolted in the piston crown and effectively prevents air circulation on its underside. However, such pistons work well in spite of the dead air pocket which at first thought might be considered as interfering with the abstraction of heat by the air movements inside the piston.

There seems to be good reason for believing that the majority of the heat is abstracted from a trunk piston engine by conduction through the walls of the piston barrel and by contact to the cylinder surface. The thick crown often found on trunk piston engines is not necessarily provided for reasons of strength, but is important because it provides an ample metal section for the escape of heat by conduction to the sides of the piston body. In fact, many piston designs now found in service are subject to criticism because the metal is disposed in the crown in such a way as to interfere with the free conduction of heat to the side walls. In Fig. 107 an attempt has been made to indicate this condition by a sketch; in the case of a piston core having the dotted outline b a corner is formed with greatly reduced metal area through which the heat can travel only sluggishly to the sides. The provision of a large radius a and the tapered wall gives the heat ample opportunity to flow

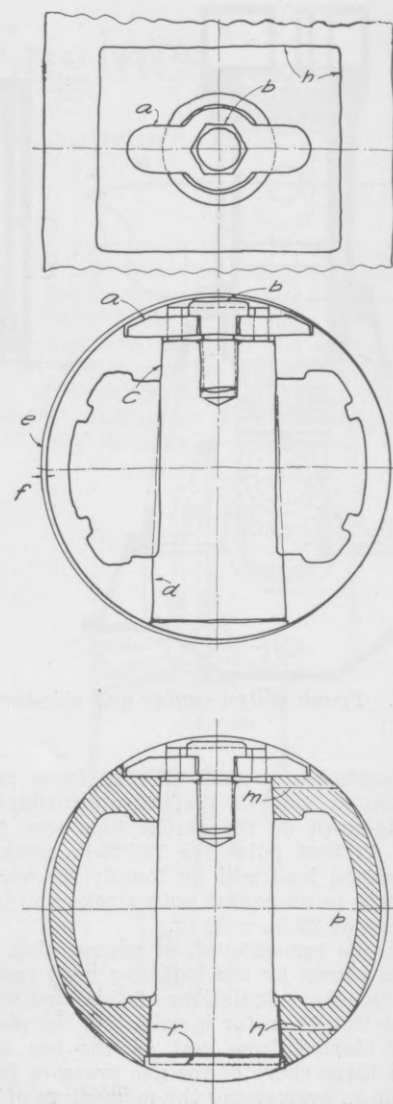


Fig. 104. Cross-sections of trunk piston

downwards and to be transmitted to the cylinder walls by the metallic contact of the piston rings. Heat coming through the piston wall f escapes via the metallic contact surfaces c and d to the cylinder wall h , in spite of the clearance gap e . From what has already been said on the subject of clearance it is obvious that the contact between the piston body and the cylinder may be imperfect. The piston rings on the other hand make accurate surface contact with the sides of the groove and the bore of the cylinder, thus acting as bridges for the transmission of heat. In fact, there are some designers who claim that a large number of rings must be provided not for holding up compression, but to transmit the heat communicated to the piston crown.

Not much reflection is required to show that the temperature of an uncooled trunk piston is generally everything but uniform. Placed in direct contact with the fire of combustion, the crown of the piston takes on the high temperatures already referred to, while the lower end of the piston skirt is in contact with the best cooled portions of the cylinder and with the air currents of the crankcase. Although not strictly correct, it is useful to assume that the temperature of the piston varies uniformly from the top end to the bottom, in other words, that the temperature at the middle is a mean between the two extremes.

Therefore, the clearance allowed on the piston diameter for taking care of expansion cannot be intelligently stated unless the height at which it is measured is also considered. It is quite customary to find figures for clearance stated in terms of thousandths of an inch per inch of diameter, and depending upon the location of the measurement almost any of the figures generally recommended can be found on the pistons generally in service. It will be

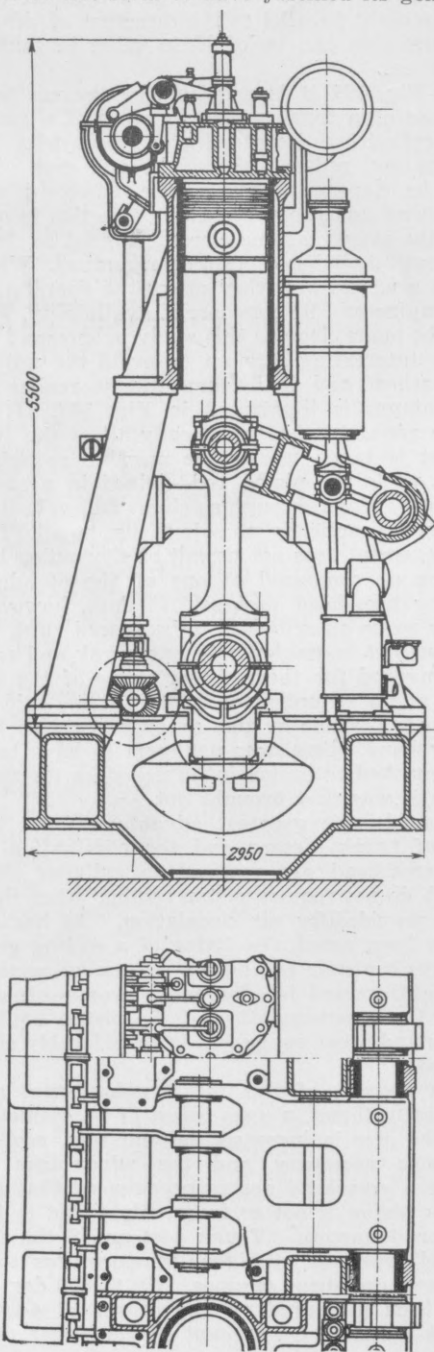


Fig. 103. Hybrid crosshead and trunk piston engine

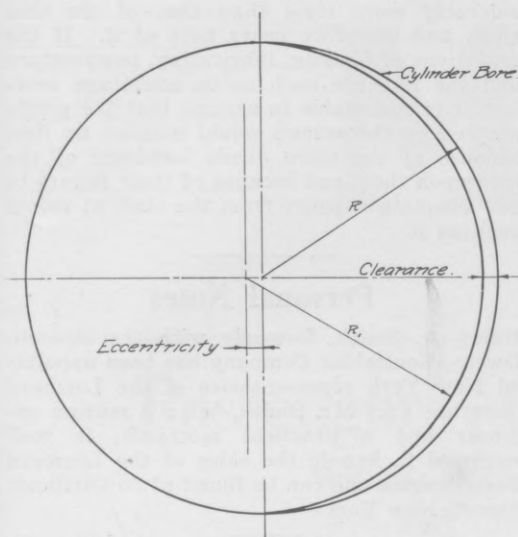


Fig. 105. Sketch of eccentric piston clearance

recalled from the preceding study of crosshead pistons that the deformation of the crown caused by heating also distorts the top end of the piston to such an extent as to render futile most of the efforts to support the crown at the center. It was also observed that this distortion communicates itself to the side walls, which must be turned down as much as 1/32 in. if seizing is to be avoided. Two thousandths of an inch per inch diameter would probably apply to some part of the piston body near the center, being far too little for the extreme top end and too large for the bottom end.

A straight piston would become conical in service, while its diameter at the top would suffer the greatest increase and the lower edge of the skirt would hardly grow at all, so that the piston would take on the form of a truncated cone with the point downwards. To allow for this, pistons are generally machined conical the other way; that is to say, with tops smaller than the bottoms as indicated in Fig. 108. When a piston thus dimensioned gets into the running condition it tends to straighten out and become truly cylindrical in such a way as to fit the water cooled cylinder bore. Figures for clearance are given on the diagram; they vary between $\frac{3}{4}$ of a thousandth per inch of diameter at the lower end and 5 thousandths at the top. It is absolutely essential that the tops of the ring grooves and the outside edge of the piston crown shall not touch, if for no other reason than that the elevated temperature of these parts would probably preclude their effective lubrication. Because of the metal to metal contact between the topmost rings and the water cooled cylinder bore, they probably remain very much cooler than the highest body portions of the piston and can consequently be lubricated sufficiently for practical purposes. In the case of pistons cooled by means of water or oil, the clearances are naturally entirely different from those just discussed.

Reference has already been made to the combination of functions in a trunk piston: collecting the gas pressure load and transmitting it partly as oblique thrust along the connecting rod and partially as lateral pressure on the piston walls. It is to be borne in mind that forces of 75 tons or more are transmitted by pistons of ordinary size. At the same time it is essential for a number of reasons that the metal weights of pistons be reduced as much as possible in the interest of preserving engine balance and of securing sound castings. Consequently the piston structure amounts hardly to more than a thin shell, the forces coming through which must be gathered up and concentrated on the massive steel wrist pin through which the driving effort of the engine is transmitted.

What may be regarded as a more or less standard form of piston is illustrated in Fig.

102, which clearly shows the crown, the thin shell and the heavy bosses for fastening the piston pin. Webbing is also shown, and it will be noted that only near the crown part of the piston, which has sufficient clearance to prevent it from bearing on the cylinder wall, are radial webs used. Over the sliding contact portion of the piston barrel all webs other than circular ones are carefully avoided for reasons which will become clearly apparent shortly.

The method of fastening the piston pin is characterized by the use of large and well-bedded contact surfaces which are necessary to prevent battering down microscopic bearing points between the metal of the steel piston pin and that of the cast iron piston. In automobile practice it is quite customary to find pins straight from end to end, and for that type of service they answer admirably. For oil engine work it has been found difficult to make straight pins that have a uniform snug bearing over their entire length that is necessary to take the continued heavy pounding. Such pins may deceive the engineer because he finds it hard to drive them in with a sledge, whereas the difficulty may be due not to the snugness of the fit but to a high spot

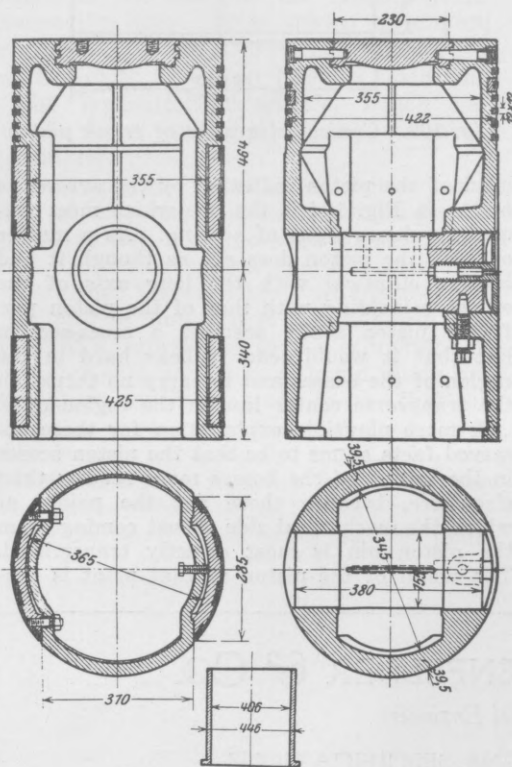


Fig. 106. Piston with separate babbitt shoes

localized in one place. Unless specially checked up, such a pin will quickly loosen in service, and when that is the case there is not much left but to throw it away and to make a new one. There is no possibility of taking up the slack which may develop.

Considerations of this kind have caused designers to adopt conical fits for piston pins as illustrated in Figs. 102 and 104. Although the two conical ends (*c* and *d*) of such a pin are ground at one setting of the wet grinder and although a single taper reamer is used for finishing the hole in the piston, the central portion of the pin which forms the bearing for the wrist pin box is turned or ground truly cylindrical. Such a pin can be driven up hard with a sledge hammer weighing from 10 lb. to 15 lb., and, should it ever loosen, additional driving will tighten it again. The taper generally selected is equal to one-half inch per foot; this is so slight that it produces an intense wedging action and may distort the piston if carelessly treated. Micrometer measurements of pistons with tapered pins of this kind generally give different indications after the pin has been driven home

from what they were before assembling. Differences in the tightness of the fit at the two ends may cause the pin to thrust one side of the shell harder than the other, thus throwing it out of round. It is essential that the bearing cones of the pin be ground into the piston with emery compound before driving it up with a sledge. The grinding wears down the high spots that prevent a more general bearing from being secured, and by increasing the amount of metal contact makes the use of excessive sledging force unnecessary.

A compromise between the straight type of piston pin and the continuous cone type is represented by the pin like that shown in Fig. 102. Although the cylindrical end of this pin is also a good snug fit, it cannot exert the same thrust on the piston shell as the conical end. Since the latter end is also the one at which the fastening and locking device is employed, further assurance is given that conical distortion will be avoided. In assembling piston pins the greatest care should be taken to see that the surfaces be absolutely clean in order that metal to metal contact be secured. Not even oil may be used, because the latter initially prevents the metal surfaces from making intimate contact with one another and later vaporizes out as the piston takes on its running temperature, leaving the joints loose. A very thin coat of the finest powdered graphite may be used to advantage because it permits the conical end to slip into place more readily, and as it cannot vaporize it has no tendency to allow loosening to take place later on.

The illustrations of piston pin fastenings already referred to show that the piston pin is held and locked not only against sidewise loosening, but also against rotation as well. In automobile practice and in some makes of oil engines a dog-point set screw accomplishes both functions. A little reflection will show, however, that the threads of the screw are called upon to take a lateral thrust on their slanting surfaces for which they were never intended. The most elaborate locking devices for set screws employed for this purpose are never altogether successful. First the pin starts to rattle loose in the threads and then it permits the piston pin to do likewise in the piston bosses. Once such loosening is started, it rapidly grows worse, and the worse it becomes the more pronounced it is bound to get.

As far as endwise retaining is concerned, the plate or bar *a* shown in Fig. 104 represents a positive and effective device. Holding a wrench on the tap bolt *b* and applying a slight strain to it while the sledging up is in progress allows the engineer to determine by the amount of jump felt in the wrench when the pin has been driven home sufficiently far. When that is the case the wrench jumps very little, and driving beyond that point can only do damage.

Securing the piston pin against rotation, as is done in the piston of Fig. 104 by means of a cross-bar fitting into milled recesses, is equally important, in spite of the fact that the connecting rod bearing should theoretically turn freely about it and should therefore

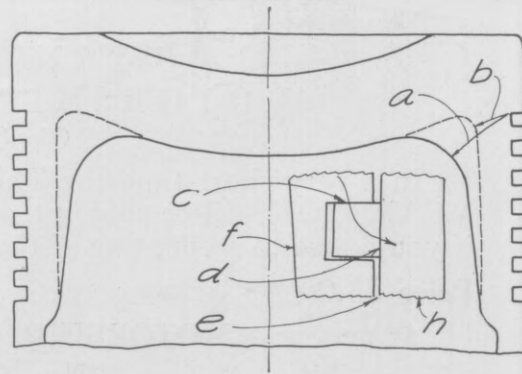


Fig. 107. Heat conduction from piston crown

not expose the pin to any rotating effort. Experience has shown, however, that innumerable repetitions of partial wrist pin box oscillations will ultimately begin to rock any pin which is effectively secured. Here again the beginning of rocking the pin about its axis is also the beginning of loosening it endwise with consequences of a serious nature. Set-screws used to prevent rotation of the pin are unsuitable for the same reason which makes them impractical for holding the pin against endwise movement. In Fig. 102 a well-fitted key like that used for fixing the flywheel on a shaft is provided to hold the pin against rotation. It need hardly be added that the side fitting of this key should be done carefully, and that the snug fit of the pin in the piston body should in no case be relied upon.

It stands to reason that the heavy sledging with which a piston pin is driven home is liable to cause bulging and distortion of the piston pin surface immediately adjacent to the holes. For that reason, generous side relief is provided over the entire area liable to be affected. This portion of the piston surface being parallel to the direction of the connecting rod side thrust, it is useless for taking up side thrust anyway. Hence it pays to make this clearance over this area deep enough to eliminate all doubt as to its touching. An area approximately rectangular in shape (Fig. 104, *h*) and from 1/32nd to 1/16th of an inch deep is generally relieved in this manner by a special grinding process or by hand filing.

Some engineers claim that a taper pin distorts the piston when it warms up and expands. That heating and expansion of the entire piston structure cause its warping is not subject to any serious doubt. The individual expansion of a taper-ended pin does not, however, seem to be a probable source of misshapen piston bodies. Reference to Fig. 104, *r* would indicate that the result of lengthening the piston pin would be to thrust its larger end, which is not secured, out of the boss, a process which would at once loosen up the taper fit and preclude the possibility of the pin's bulging the piston casting at that point. It is not unlikely that the theory of piston pin expansion originated in the perfectly correct observation that the neighbor-

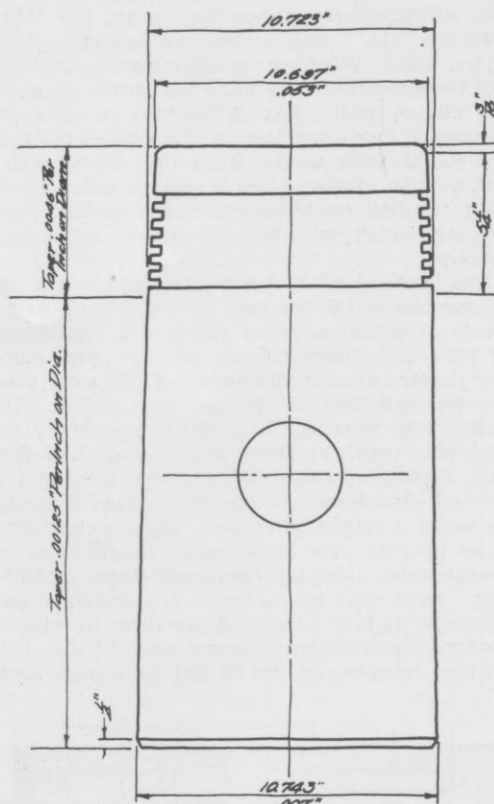


Fig. 108. Conical clearance of trunk piston

hood of the piston indicated by the arrows *m* and *n* in Fig. 104 is the one which most frequently shows signs of scoring. As a matter of fact, the piston does act as though it had become elliptical with the long axis of the ellipse coinciding with that of the piston pin. If the piston really assumes a cross-section like that it would tend to bear hard in the region of the bosses and to carry no thrust on the transverse center line in the region of *p*.

A more plausible explanation for these observed facts seems to be that the piston scores in the region of the bosses more readily than elsewhere, because those are the points at which the mechanical side thrust coming from the piston pin is most directly transmitted. The metal of the piston at that point is con-

siderably more rigid than that of the thin shell, and therefore bears part of it. If the conditions of loading, lubricating, temperature and the like are such as to encourage scoring, it is reasonable to assume that the points marked by the arrows would roughen up first because of the more direct incidence of the load upon them and because of their failure to get adequate support from the shell at points such as *p*.

Personal Notes

Harry A. Smith, formerly with the Hooven, Owens, Rentschler Company has been appointed New York representative of the Lombard Governor Co. Mr. Smith, being a marine engineer and a practical mechanic, is well equipped to handle the sales of the Lombard Diesel engine and can be found at 39 Cortlandt Street, New York.

W. Merton Rice, until recently New York representative of the Lombard Governor Company, is now managing director of Henry Gielow & Co., Inc., Architects, 25 West 43rd Street, N. Y. C. Mr. Rice is an old associate of the late Mr. Gielow.

Catalogs

Brown New Design Recording Pyrometers, Bulletin 1-13. The Brown Instrument Co., Philadelphia, Pa.

Atlas-Imperial Diesel Engines. Catalog No. 25—48 pp. describing the Atlas engines and listing the various equipment built by the company. Atlas-Imperial Engine Co., Oakland, Cal.

Indicating Thermometers, Bulletin No. 148—36 pp. The Foxboro Co., Inc., Foxboro, Mass.

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